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JOURNAL

Heating • Refrigerating • Air Conditioning • Ventilating

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS

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Closed system air conditioning better, less costly? page 39

We propose a new humidity standard page 44

Here is a simple method of comparing heat exchangers page 50

How effective are drapes in reducing solar heat gain? page 53

JUNE 1960

WHY TRAP-DRI®?

BECAUSE

costly Egyptian cotton plus deep filtration tunnels give 5 to 9 times* the filtering area of conventional filters

*For particles down to 5 microns in size.

The diamond pattern on the filter element is no mere decoration. It's a pattern behind which you'll find a honeycomb of diamond-shaped tunnels for full-depth filtration. This filter design can only be achieved through use of expensive, long-fibre Egyptian cotton. Just one of the investments we make to give you refrigeration's finest drier-filter-strainer . . . perfect protection against corrosive acids, moisture, dirt.

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Surface-type filter (left) — Dirt collects on outside only, gradually closing filter.

410 filter (right) — Dirt is collected in deep, large-capacity tunnels without clogging filter.

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JUNE
1960

VOL. 2 NO. 6

OFFICIAL PUBLICATION

JOURNAL

Formerly Refrigerating Engineering including Air Conditioning, and incorporating the ASHAE Journal.

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AN IMMINENT TOMORROW

When we subheaded the news report of the BRI Spring Conference in our May issue as the "Brave New World of Air Conditioning" we were doing more than borrowing a now-dusty title from Aldous Huxley.

That Conference was, indeed, a hard look into the reasonably far future. From the overall aspects of the atmosphere, as we know it, through odor and particulate controls, to the urgencies of a wholly altered viewpoint toward hospital asepsis, to the nuclear age as it affects us all, and to the concept of preeminently desirable closed circuit air conditioning, it was a most stimulating and comprehensive experience for a literally rapt audience. We recommend that those readers who failed to read the report in May backtrack for a double take.

In this issue, Past President John E. Haines of ASHRAE (who not incidentally presided at the BRI Conference) takes us all for a highly tangible excursion through prevailing data as to costs, methods and results with closed circuit air conditioning methods. This, too, comes close to being required reading for the alert engineer in our fields of heating, ventilating and air conditioning.

LAST CALL FOR VANCOUVER

By the time this issue reaches our member-readers there will be little time for last minute decisions as to whether or not to go to the 67th Annual Meeting in Vancouver.

All we know about it is that, from every indication as to program, social events, Host Chapter efforts and the natural attractions of the city and the region, those who do not attend will be missing a proverbial "lost opportunity; seldom regained".

Edward R Searles
Editor

Late news highlights

Noise reduction Planned primarily for engineers in industry who are faced with the solution of noise problems, a Special Summer Program on Noise Reduction will be held at the Massachusetts Institute of Technology from August 22 through September 2 as part of the 1960 Summer Session. Analysis of noise problems, the measurement of noise and the application of modern techniques will be emphasized. Tuition is $300.

Fractional hp motors Various types of fractional horsepower motors used in appliances, including split phase, capacitor, repulsion, shaded pole, universal and three phase motors, together with troubleshooting charts for each of these motors, are covered in *Basics of Fractional Horsepower Motors and Repair* by Gerald Schweitzer. Also included are chapters on motor testing, with emphasis on short circuits and motor grounding; care and maintenance of motors; enclosure and mounting characteristics; and control devices. Published by John F. Rider, Inc., 116 West 14th Street, New York, N. Y.; copies of this 168-page illustrated book are available for $3.90.

Improved tube-in-sheet Development of an improved form of aluminum Roll-Bond tube-in-sheet – used by nearly all major refrigerator manufacturers for the evaporator plates that comprise the cooling units of freezer compartments – has been announced by the Metals Division of Olin Mathieson Chemical Corp. The new form is a bi-alloy version, one side of which is made of a harder, tougher aluminum highly resistant to damage by ice picks and other sharp implements and is expected to result in substantially reduced refrigerator service and repair costs.

Proprietary rights According to "A Survey of Employer Practices and Expectations Concerning the Safeguarding of Proprietary Rights" prepared by the Employment Conditions Committee of Engineers Joint Council, the engineer generally is expected to determine for himself what information gained on one job he may utilize on a subsequent job, bearing in mind that he or his new employer may later be held legally accountable. Responses to questionnaires submitted to 800 major industrial companies which employ engineers indicated that wide use is made of employment agreements which protect current employers, but only in rare instances are previous employee agreements investigated. Single copies of the report may be obtained from EJC, 29 West 39th Street, New York 18, N. Y.

Newest ARI Directory Distribution of a second-quarter Directory of Certified Unitary Air Conditioners, listing some 2150 unitary models of 48 manufacturers participating in the ARI Unitary Air Conditioner Certification Program, has been announced by the Air Conditioning and Refrigeration Institute. Directory is available through numerous sources including ARI, 1346 Connecticut Avenue, N.W., Washington 6, D. C.

New publication Data on radiation levels in air, water and milk comprise the bulk of the first issue of "Radiation Health Data," a new monthly technical publication giving levels of radioactivity in the environment. Prepared by the Public Health Service under a delegation by the Secretary of Health, Education and Welfare, the publication is available from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. Price is 50 cents per single issue and $3 for a 6-month subscription.

In five languages *Dictionary of Refrigerating Engineering and Air Conditioning, Heating and Ventilation* translates the vocabulary used by American experts in these fields into German, French, Italian and Spanish to ease an exchange of ideas within these special branches. Technical terms are arranged alphabetically in English, followed by translations into the four languages. An index of each foreign language is included. This book is available from Axel A. Lindow, Verlag fur Wirtschaft und Technik, Hamburg-Blankenese, Am Sorgfeld 110, Germany.

International research Proceedings of a program conducted as part of the 1959 Fall Conference of the Building Research Institute, including reports on current building research in Canada, South Africa and Japan, have been published in "Building Research, International." Copies of this 44-page report may be obtained from the Printing and Publishing Office, National Academy of Sciences-National Research Council, Washington 25, D. C., for $1.50.

Problem for historians How to locate and save the original papers of great American scientists whose personal memorabilia might otherwise be lost was the problem confronting a group of scientists, historians and other specialists who met in Washington, D. C., on May 5 and 6. The National Science Foundation, through a grant to the History of Science Society, provided funds for the conference.

All electric homes Sixteen model homes in which electricity does everything–including the heating – are being erected throughout the United States as part of a program initiated by Westinghouse Electric Corp. and co-sponsored by local utilities to show that any kind of home can be totally electric. One of the first homes to be completed, in Jackson, Miss., has a controlled environment on a year-round basis through use of a heat pump.

Cryogenic data Volumes 1-5 of *Advances in Cryogenic Engineering*, edited by K. D. Timmerhaus, which contain proceedings of the Cryogenic Engineering Conferences held since 1954, provide an authoritative collection on research and development in this field. Volumes 1-4 have been reprinted in new editions; Volume 5 is available for the first time. Price is $13.50 for each volume (special rate of $35 for the first four volumes). Plenum Press, 227 West 17th Street, New York, N. Y.

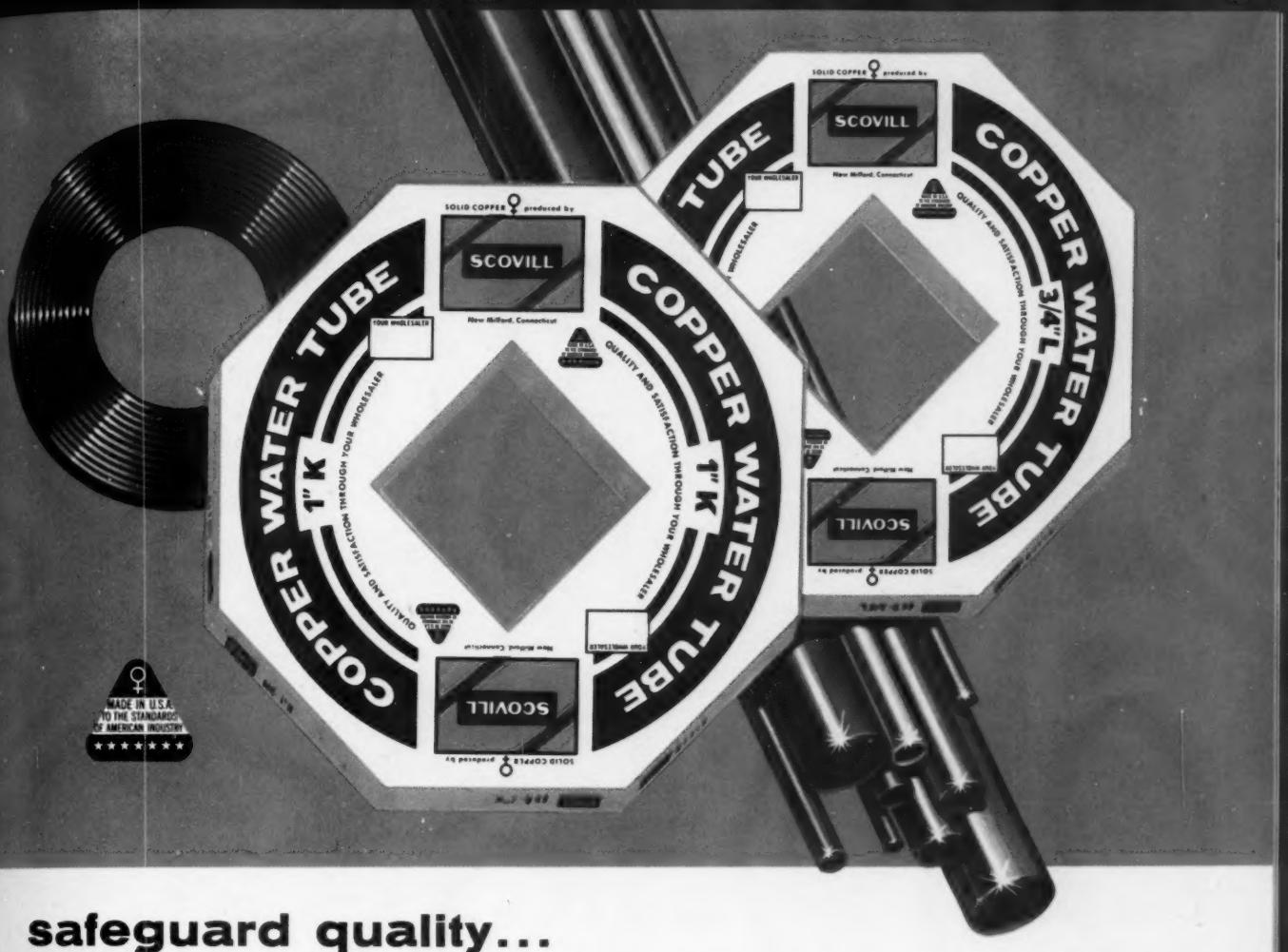
Closed circuit respiratory systems Designed to exchange scientific information vital to man's extended space flight, a symposium on closed circuit respiratory systems, sponsored by the Wright Air Development Division, Wright-Patterson Air Force Base, was held in Dayton, Ohio, on April 28 and 29. Work being done in the concentration and decomposition of exhaled carbon dioxide and water vapor, and the instrumentation necessary for process control were emphasized at this meeting.

Reasons for decline Increased interest by qualified students in other fields of science; concern over the rigors and demands of engineering education; and decrease in application from students lacking in interest and motivation for engineering are reasons cited for the decline in freshman engineering enrollment in a special survey prepared by the Engineering Manpower Commission of Engineers Joint Council. It was found that geographic areas most affected by the enrollment decline are the South, South Central and Mountain states, with public institutions in these areas affected most. Copies of this study are available from EJC, 29 West 39th Street, New York 18, N. Y.

Introduction to thermodynamics *Engineering Thermodynamics* – An Introductory Textbook by J. B. Jones and G. A. Hawkins is intended primarily for use in undergraduate courses in thermodynamics to help students develop an understanding of the first law, second law and some physical property relationships and, further, to acquire competence in the application of these principles to engineering systems. Numerous problems are included within this 724-page book, published by John Wiley & Sons, 440 Fourth Avenue, New York 16, N. Y. Price is $8.50.

Research at Battelle A research program to identify cooling systems that may improve the overall effectiveness of ground-based Air Force electronic equipment has been initiated at Battelle Memorial Institute, Columbus, Ohio. Authorized by the Air Research and Development Command's Rome Air Development Center, the one year study will cover well-established refrigeration techniques as well as experimental ones.

You and ASHRAE Briefly outlining the purpose and activities of our Society, the pamphlet "You and ASHRAE" explains how members benefit, lists qualifications for membership and describes the various publications made available to members.



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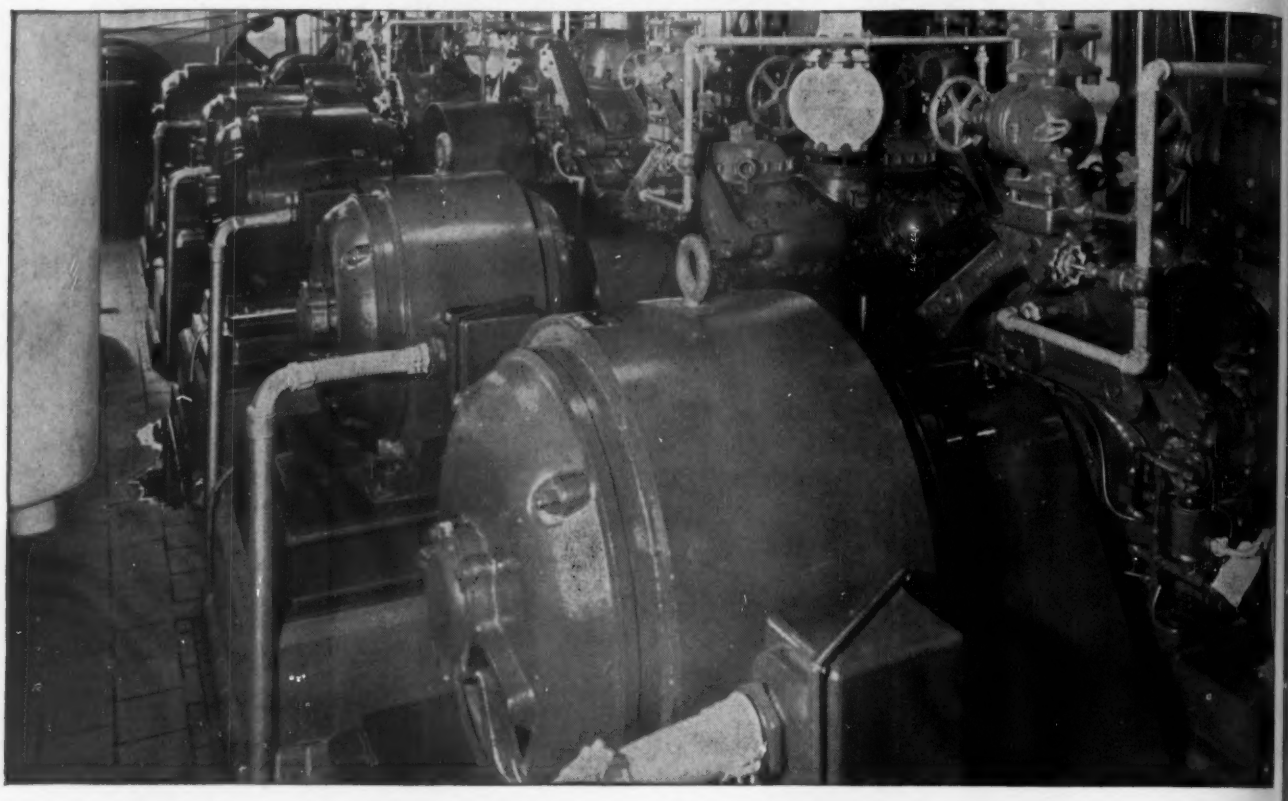
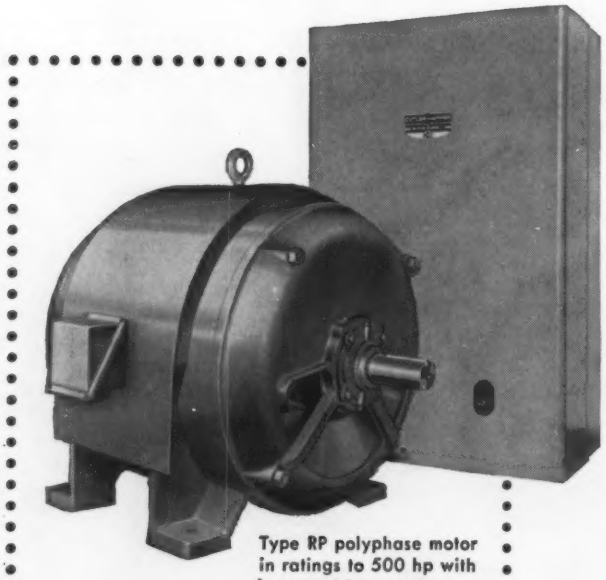
WAGNER ELECTRIC MOTORS . . . THE CHOICE OF LEADERS IN INDUSTRY



End Voltage Drop and Line Disturbance Problems caused by starting BIG MOTORS...



Type RP polyphase motor in ratings to 500 hp with increment type starter.

Use Wagner Increment Motor-Starter Combinations

Increment starting is the easy, inexpensive way to limit the inrush of starting current in motors up to 500 horsepower. And, you do it *best* with Wagner Increment Motor-Starter Combinations . . . polyphase open-type, totally-enclosed, or explosion-proof motors and magnetic increment starters.

Line disturbances are reduced because current taken from the line is not broken during the starting period. Motors start sure and fast . . . reach full speed in a matter of seconds. And . . . Wagner combinations cost less than motors with primary resistance or auto-transformer type starters.

Two more plusses: The compact, relatively lightweight starter is easy to connect . . . needs very little attention. The motor requires only regular inspection, cleaning, and lubrication . . . maintenance is minimized.

While 2-step combinations are suitable for most applications . . . 3, 4, 5, or 6-step increment motor-starter combinations are available for installations where unusually low inrush of starting current is required. All meet the polyphase motor-starting requirements of AEIC-EEI-NEMA.

It's possible you can save money on your big jobs with Wagner Increment Motor-Starter Combinations. A Wagner Sales Engineer will help you. Call the nearest Wagner branch or write us for Bulletins MU-128 and MU-195.

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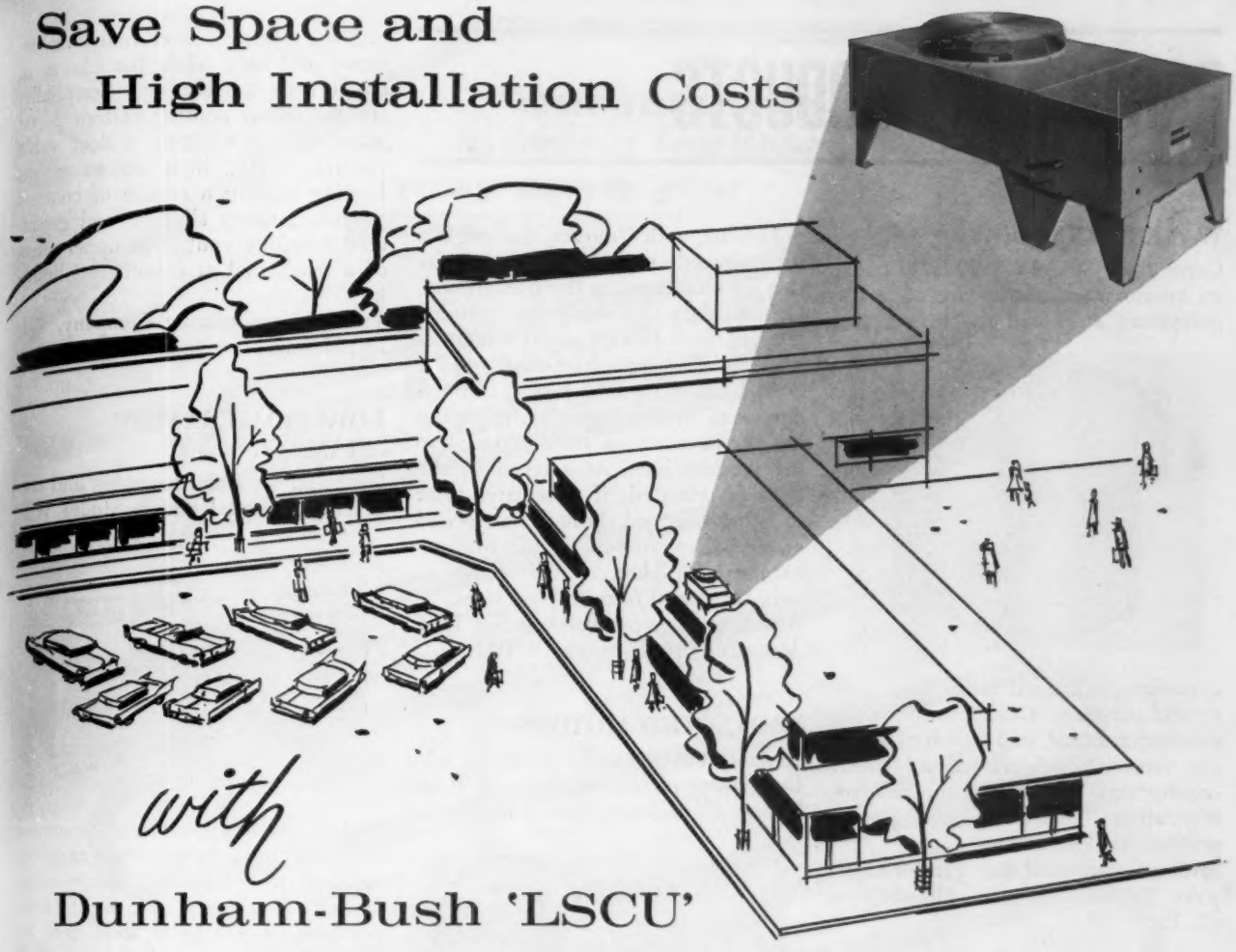
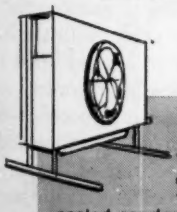
Save Space and High Installation Costs



with

Dunham-Bush 'LSCU'

Low Silhouette Condensing Unit

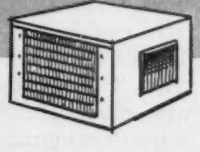


LRCU

The "LRCU" is basically a standard "BC-P" remote air cooled condenser with a Brunner-Metic motor-compressor, Heat-X liquid receiver, electrical controls, and refrigeration accessories added. All are interconnected and installed within the casing of the "BC-P" unit. Capacities range from 10-30 tons.

RCU

Remote Condensing Unit Assemblies—These units are designed for use with remote dry expansion coils and include inner-fin condenser coils, Brunner-Metic compressors and blower fan and motor. Suction and liquid lines can be easily connected in the field.



Perplexing space problems and high installation costs, inherent in ordinary 'built up' air conditioning systems, can be eliminated by specifying the Dunham-Bush "LSCU".

These Dunham-Bush Low Silhouette Condensing Units are available in five basic sizes, 10 through 30 tons, specifically designed for air conditioning applications requiring the use of water savers. Installed with complementary Dunham-Bush "AH" Air Handling Units, they provide a complete installation.

The "LSCU" is basically a standard "LSBC" low silhouette blower condenser with a Brunner-Metic motor-compressor, Heat-X liquid receiver, electrical controls and refrigeration accessories added in a separate section for field attachment or remote installation. All motors are specifically designed for outdoor use.

"LSCU" units can be located anywhere without regard to prevailing winds. The air movement, up and out, means minimum noise rating and no objectionable air flow.

All enclosures are designed for outdoor use and constructed to permit easy accessibility for maintenance.

For more information request Form No. 7017-1.

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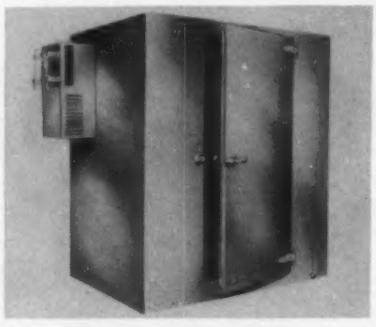
BRUNNER CORPORATION (CANADA) LTD. PORT HOPE, ONTARIO

PARTS and PRODUCTS

WALK-IN COOLERS

Capacity of Model CV-90 is 90 cu ft, its interior and exterior are of heavy galvanized steel and the former has



a watertight flanged metal floor over a solid sub-floor. Coolerette units are weather resistant and capable of being erected outdoors, of all metal construction and with unitized refrigeration factory assembled and positive air circulation.

Jordon Commercial Refrigerator Company, 2200 Kennedy St., Philadelphia 37, Pa.

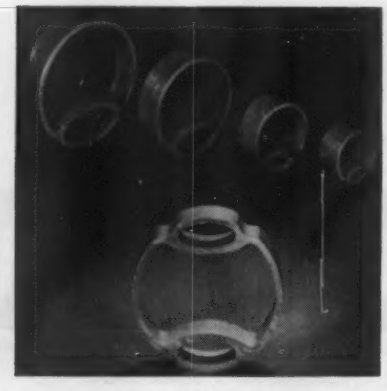
COMBINATION UNIT

Featured in one compact ceiling-type unit are heating, ventilating and lighting, controlled by a three-way switch plate. Designated Model 5412, it has a forced air circulating heater and quietly-operating exhaust blower combined in a lighting fixture.

Leigh Building Products Div, Air Control Products, Inc., Coopersville, Mich.

TUBULAR PRODUCT

With built-in channels to simplify and reduce the cost of recirculating heat-

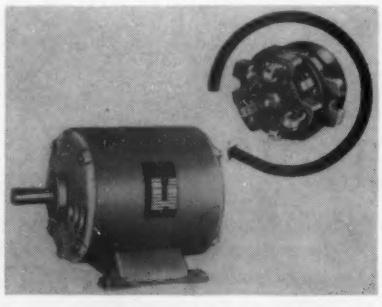


ing fluids required in piping systems, Duotrace is shown in the foreground of the cut, with Unitrace, the original steam-traced piping introduced by this manufacturer, in the background. Contained in this one-piece extruded section are two integral channels flanking a large, product carrying pipe area. Heating medium travels through one small oval passageway, maintaining temperature of bulk material in the product line. At a terminal, the fluid is reheated, if necessary, prior to being returned through the second channel. Designed specifically to eliminate extra piping, it is available in two, three and four-in. pipe sizes.

Aluminum Company of America, 1501 Alcoa Bldg., Pittsburgh 19, Pa.

PROTECTED MOTORS

Inherent automatically protected motors (three-phase, ¼ through three hp, ac) form a new line consisting of



67 different types of open motors in a wide variety of voltages, speeds and mountings. Self-protection, from both temperature and current, is provided against severe overloads, stalling, single phasing, unbalanced voltage, high ambient temperatures and motor ventilation obstruction. Protector is assembled and wired, inside the motor, at the factory.

Kingston-Conley Inc., div of Howell Electric Motors Company, 900 North Ave., Plainfield, N. J.

GAS-FIRED HUMIDIFIER

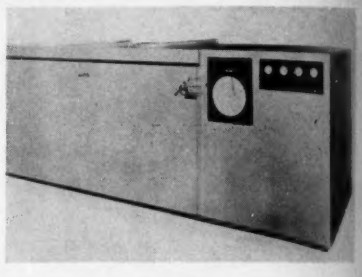
Max capacity of the Valley/Aire is 24 gal of water vapor in 24 hr. For commercial applications, several units can be used where higher capacities are needed. Maintenance of up to 40% relative humidity in areas of 30,000 to 40,000 cu ft when outside temperature registers zero F is cited for the equipment.

Through humidifier controls, the unit introduces water vapor directly into the warm air duct system on demand and only while the blower of the furnace is operating. Essentially, the humidifier consists of four parts: water system utilizing a float valve control; small, high efficiency gas heating system; a system of controls providing safety shut off and graduated humidity control in upper areas of a residential or commercial building.

Valley Manufacturing Company, Valley, Nebr.

LOW TEMPERATURE CHAMBER

Designed for fast processing and stabilizing of metal alloys, Model WT-



54-125 low temperature environmetal chamber has a temperature range of ambient to −140 F. Refrigeration capacity is sufficient to lower the temperature of 300 lb of steel from 80 F to −125 F in one hr.

Inside working dimensions are 72 x 36 x 36 in. Interior is constructed of 16 gauge stainless steel, with the bottom reinforced to withstand 1000 lb/sq ft. Temperature is recorded and controlled by a 12-in. recorder-controller with controls flush-mounted. Chamber is self-contained, requiring only connection to electrical and water service. It is available with 220 or 440 volt, three-phase, 60 cycle power.

Webber Manufacturing Company, Inc., P. O. Box 217, Indianapolis 6, Indiana.

FILTER ASSEMBLIES

For use in the filtration of most fuels, lubrication oils, hydraulic fluids, air and other gases and liquids, this new line of general purpose filter assemblies, Series 3100, has pore size ratings from two to 100 micron and is available with five different element materials. These materials include: woven wire cloth, sintered bronze, pleated resin-impregnated cellulose sheet, stacked resin-impregnated cellulose washers and helically wound resin-impregnated cellulose ribbons. Overall temperature range covered by these elements is −350 to 350 F.

Flow rate and pressure drop ratings for these filters are dependent on filter

Our fabulous serpentine forming facilities may save you MONEY!

TOP REFRIGERATION PEOPLE DEPEND ON TOP TUBING PEOPLE

GM Steel Tubing specialists are ready to help you solve any steel tubing problem. Their proficiency in forming serpentines is an excellent case in point. Because we have a quantity of multiple benders, we can often adapt one of these instead of starting from scratch. This saves you time and tooling costs. Remember, too, that rotary-straightening of GM Steel Tubing insures flat-as-a pancake serpentines and this speeds up your wire welding for higher production. These characteristics, plus GM Steel Tubing standards for quality, strength, cleanliness and on-time delivery have made it tops with refrigeration people.

Write or wire GM Steel Tubing Sales Manager, *Rochester Products Division of General Motors, Rochester, New York.*

GM Steel Tubing serpentines are "profile" checked for close adherence to your specifications. Dimension, flatness, pressure and cleanliness tests insure the reliability for which GM Steel Tubing is noted.

GM

STEEL TUBING
BY ROCHESTER PRODUCTS

RP

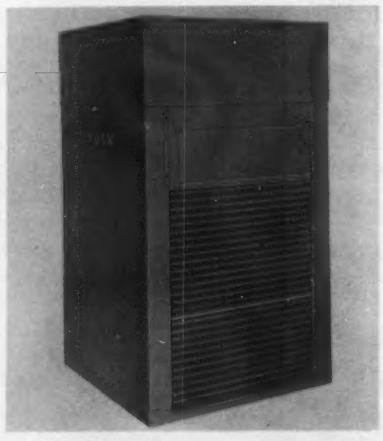
AMERICA'S LARGEST MANUFACTURER OF REFRIGERATION TUBING

element materials and fluids to be filtered. Rated operating pressure is 150 psi, with a burst pressure of 600 psi. Housings are fabricated from aluminum and are blue anodized.
Bendix Filter Div, Bendix Aviation Corporation, 434 W. 12 Mile Rd., Madison Heights, Mich.

PACKAGED LINE

Entirely a remote series, with an outside heat exhaust section and a variety of inside evaporator sections, the air-cooled packaged Champion line features low ambient, enabling units to operate during cold weather periods. Six outside exhaust sections are included in the line, with capacities ranging from 4.7 to 15.7 ton.

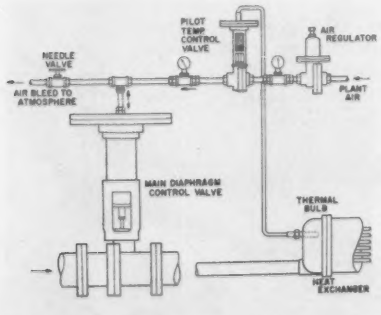
Inside coil sections are available in self-standing, ceiling suspended or



direct-to-duct-work units. A line of plenum models is available for elimination of ductwork. Coils are available also for direct application in ductwork, using existing blowers.
York Div, Borg-Warner Corporation, York, Pa.

TEMPERATURE VALVE

Now available in four and six-in. sizes, this sliding gate temperature control valve, air operated, has ca-



pacities to 50,000 lb of steam per hr or 2500 gpm of water. Use is for heating or cooling service, wherever large capacities, accurate control and tight shut-off are required. Typical industrial applications of the regulator are controlling temperature in heat exchangers, cooling jackets, water condensers and similar uses. System is suitable for pressures to 250 psi and temperatures to 500 F and will control temperature from 35 to 450 F. No. 180-170 F valve is cast iron with 125-psi ASA flanges and No. 180-370 F is ductile iron with 250-psi ASA flanges. Both stocked, pilot valve is ¼-in. screwed end, ductile iron, with special sliding gate pilot seats. Thermal bulbs are available in copper, stainless steel, plastics covered copper, with capillary and armor of similar materials.
OPW-Jordan Corporation, 6013 Wiehe Rd., Cincinnati 13, Ohio.

NOTCHED V-BELT

Primary advantages claimed for the CX V-belt are quiet, vibrationless running characteristics; greater flexibility, permitting it to run smoothly over smaller pulleys; and fully molded and jacketed construction eliminating flex-cracking and increasing fatigue resistance. Its fabric covered body also resists cross-sectional distortion, maintains lateral stability and resists changes in effective length.

Raybestos-Manhattan, Inc., Manhattan Rubber Div, Passaic, N. J.

REGULATING VALVES

Series 246 water regulating valves are now available in all-range (Refrigerants 12 and 22) construction in larger sizes. New sizes are one, 1¼ and 1½ in. Previously all-range valves were manufactured in ⅜, ½ and ¾-in. sizes only. Also available in Series 247 (reverse action) are valves designated as low range construction. They are used primarily on heat pump applications to modulate the water to the heat source exchanger, providing max extraction of heat from the water.
Penn Controls, Inc., Goshen, Ind.

AIR-COOLED UNIT

Added to the Luxaire line of summer air conditioning units is a four-hp air-cooled condensing unit, housing compressor, condenser coil and fan in one unit, designed for remote installation out-of-doors. When tested under standard conditions of 95 F ambient air temperature and 80 F dry bulb and 67 F wet bulb air temperature entering the cooling coil, unit provides cooling capacities of 46,800 Btu/hr with the plenum type coil, 46,500 with the duct-type coil and 47,000 with the counterflow coil.

Condenser coil is mounted across the top of the cabinet, with a large propeller fan housed inside the cabinet, blowing cooling air through the condenser coil, from which it is discharged at low velocity. Design permits installation of the unit under overhanging eaves.
C. A. Olsen Manufacturing Company, Elyria, Ohio.

DAMPER REGULATOR

Of extra-heavy construction, rectangular in shape and for use on dampers up to 20 in., this ⅜-in. regulator is cited as minimizing damper rattles and air leakage. Designated Wedge-Loc because of its wedging and locking action, it has an indicator dial which is easy to read and adjust.

Duro-Dyne Corporation, Rte. 110, Farmingdale, N. Y.

PUMPS

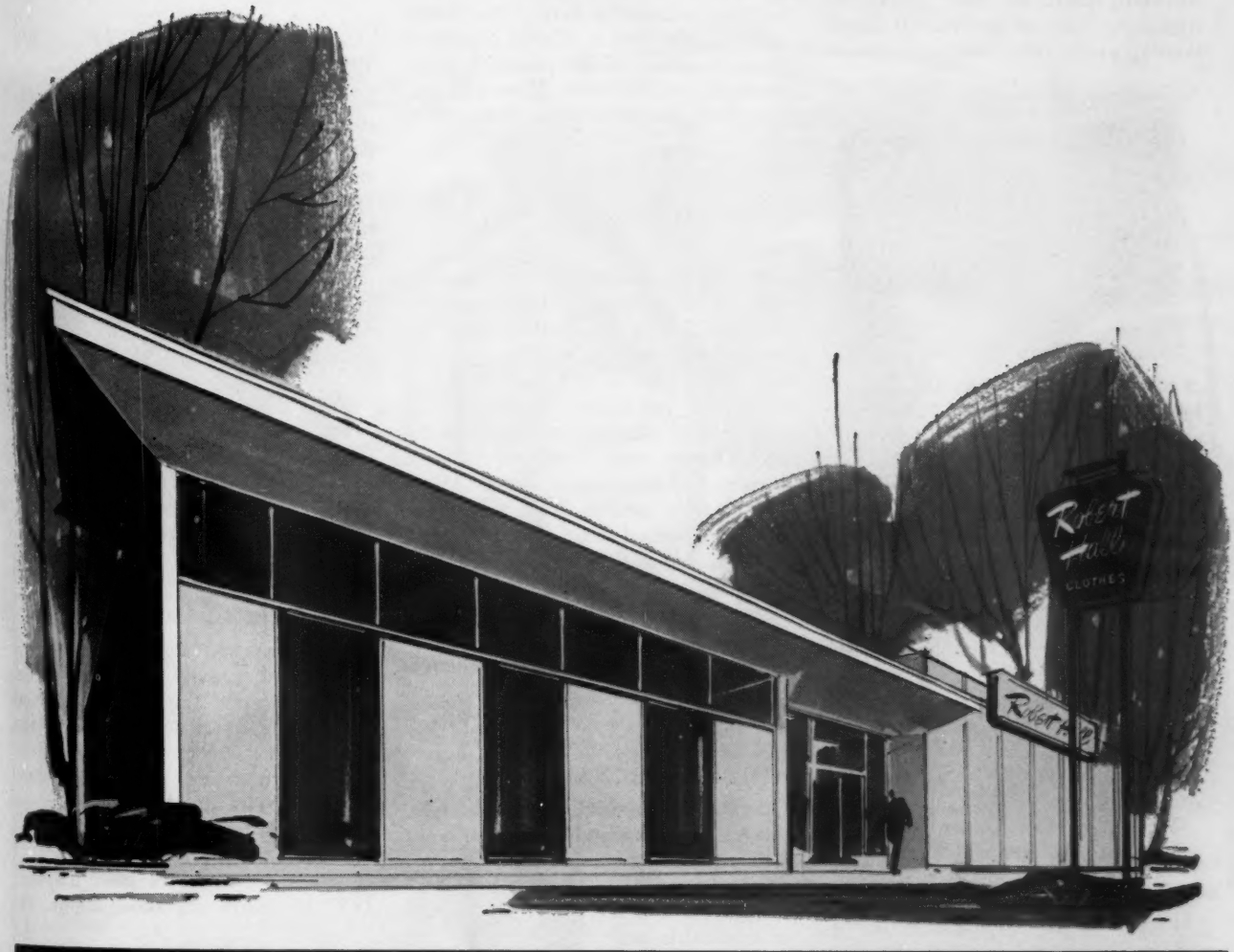
Econobloc pumps, available in six sizes in the fractional hp range, deliver up to 80 gpm and heads to 110 ft. They feature high efficiency, an easily replaceable mechanical seal and compact design. Die-cast aluminum bronze impellers with shell-molded casings insure smoother waterways and, on the smaller sizes, the mechanical seal can be serviced without disturbing either suction or discharge piping.
Worthington Corporation, Harrison, New Jersey.

ELECTRONIC CLEANERS

For installation in homes and smaller commercial and industrial buildings,

this new line of electronic air cleaners will be available in five models. These new units were made possible through reduction of ionizing-collecting cell

Climate by Chrysler



Robert Hall Clothing Store No. 330, Maple Shade, N. J., typical of the twelve stores cooled by Chrysler Air Conditioning

Chrysler Packaged Air Conditioning to cool 12 more stores for Robert Hall

Robert Hall Clothing Stores are springing up around the country like daisies after a summer storm. And in each of the last twelve stores you'll find Chrysler Packaged Air Conditioners to keep customers cool.

All of these stores use versatile, low-cost Chrysler 20-ton air-cooled units. But where local conditions warrant, Chrysler also can supply water-cooled equipment in the most complete range of capacities.

On a cost-per-square-foot basis, Chrysler Air Conditioning has proved to be the most economical to install. And, it costs less to operate and maintain. Robert Hall has already demonstrated this to its satisfaction in dozens of other stores from New York to California.

Robert Hall, like so many other large chain store operators, has learned Chrysler delivers the best all-around value for their air conditioning investment. There are many reasons why. For details or technical cooperation of a Chrysler Air Conditioning Engineer, write today.

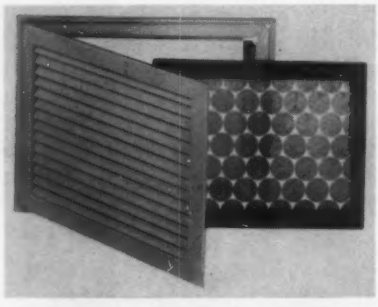
CHRYSLER
AIRTEMP

Airtemp Division, Chrysler Corporation, Dept. Z-60, Dayton 1, Ohio
In Canada: Therm-O-Rite Products, Ltd., Toronto, Ontario

plate spacing to 5/16 in. and application of other refinements in cell and power pack design.
Electro-air Cleaner Company, Inc., Olivia and Sproul Sts., McKees Rocks, Penna.

FILTER FRAMES

Air-Mate return air filter frames, designed for use on central air conditioning units, offer fast replacement

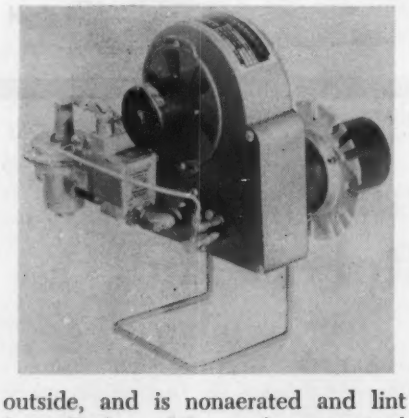


of dirty filters, because the grille is hinged to the frame. Frames are available in standard sizes from 10 x 10 to 36 x 36 in.
Dry Manufacturing Company, Inc., P. O. Box 797, Winters, Tex.

DOMESTIC POWER BURNER

Designed for conversion of down draft and horizontal type heating units and units that have insufficient combustion area to fire the necessary input with an atmospheric burner, this unit is available in two models, of 200,000 and 400,000 Btu/hr max input, respectively.

Pilot is of the runner type, with orifice quickly removable from the



outside, and is nonaerated and lint free. Both models are factory wired and tested before shipping.
Liberty Combustion Corporation, E. Molloy Rd., Industrial Park, P. O. Box 300, Syracuse 1, N. Y.

AUTOMATIC RELIEF VALVE

Extra heavy red brass body, test lever, stainless steel control spring, special washer and 7-in. exposed (8-in. overall) straight extension tube are features of Mansfield 501. Free from bulbs or other obstructions, the extension tube is cited as assuring unrestricted flow when installed in a hot water line.

Operation of the valve starts at 200 F and it is wide open at 210 F. After temperature drops below 200 F, the washer seals off the 8/16-in. seat opening to close the valve. Btu steam rating of the unit is 95,000. Standard pressure setting is 125 psi, with other settings available from 75 to 175 psi.
Mansfield Sanitary, Inc., Perrysville, Ohio.

51-FRAME FAN MOTORS

Designed for applications requiring a motor to operate for extended periods without maintenance, this company has introduced a 3½-in. diam, 51-frame, unit-bearing shaded-pole motor. Operation is as a condenser or evaporator fan motor on food coolers, refrigerated display cases, domestic refrigerators and freezers, walk-in coolers and condensing units. Motor can also be used to drive air-moving device on forced-draft space and room heaters, fans and blowers. Designated Type KSP, they are single-phase and rated 1.5 to 16 watt, 115 and 230 volt, 60/50 cycle.
General Electric Company, Schenectady 5, N. Y.

ADJUSTABLE VALVE

Operating on a single pivot principle, the A-1106-9 is simplified to the point where it has no moving parts. All-rubber valve seat is adjustable and can be reversed;

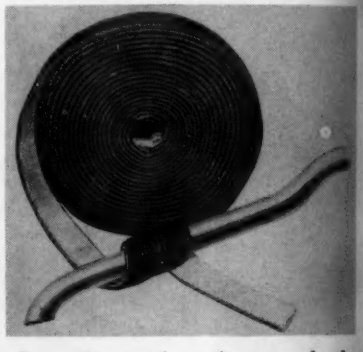
design of the seat enables it to act as a splash shield. Manufacturer recommends this valve and foam glass float assembly for evaporative coolers, ice making machines and other automatic water control operations.
Skuttle Manufacturing Company, Milford, Mich.

GAS AIR CONDITIONER

Gas flame burning outdoors powers this air conditioning unit. As embodied in this design, heat applied to the outdoor unit produces chilled water, which is pumped through plastics hose to and from a cooling coil located within the house. This coil can be installed in a typical air system, whether the furnace be upflow, downflow or horizontal, and whether located in an attic, crawl space, basement or utility room. Since the system is factory-charged with refrigerant and shipped as a hermetic system, there are no refrigerant lines to run, dry and purge. With heat as the energy source, any gas service adequate for house heating is also adequate for cooling.
Bryant Manufacturing Company, 2020 Montcalm St., Indianapolis 7, Ind.

WRAP-ON INSULATION

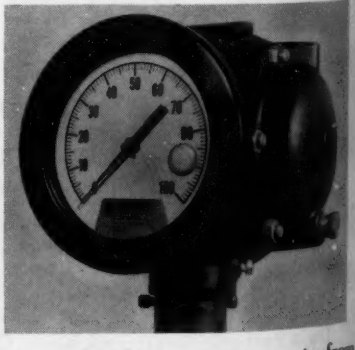
Insutape, a wrap-on asbestos pipe insulation that is cited as being both flameproof and weatherproof, is designed for a wide variety of industrial applications requiring an easy-to-apply material. It consists of long-fibered asbestos rovings, completely enclosed in a tubular, woven asbestos



jacket. Exposed surfaces and edges are coated heavily with Neoprene. Snug fit around the pipe is achieved by working spiral wrappings with the hands and pressing tape edges firmly together to assure max conservation of heat. Wire bands or clamps used at intervals hold the insulation firmly in place.
Union Asbestos & Rubber Company, 1111 W. Perry St., Bloomington, Ill.

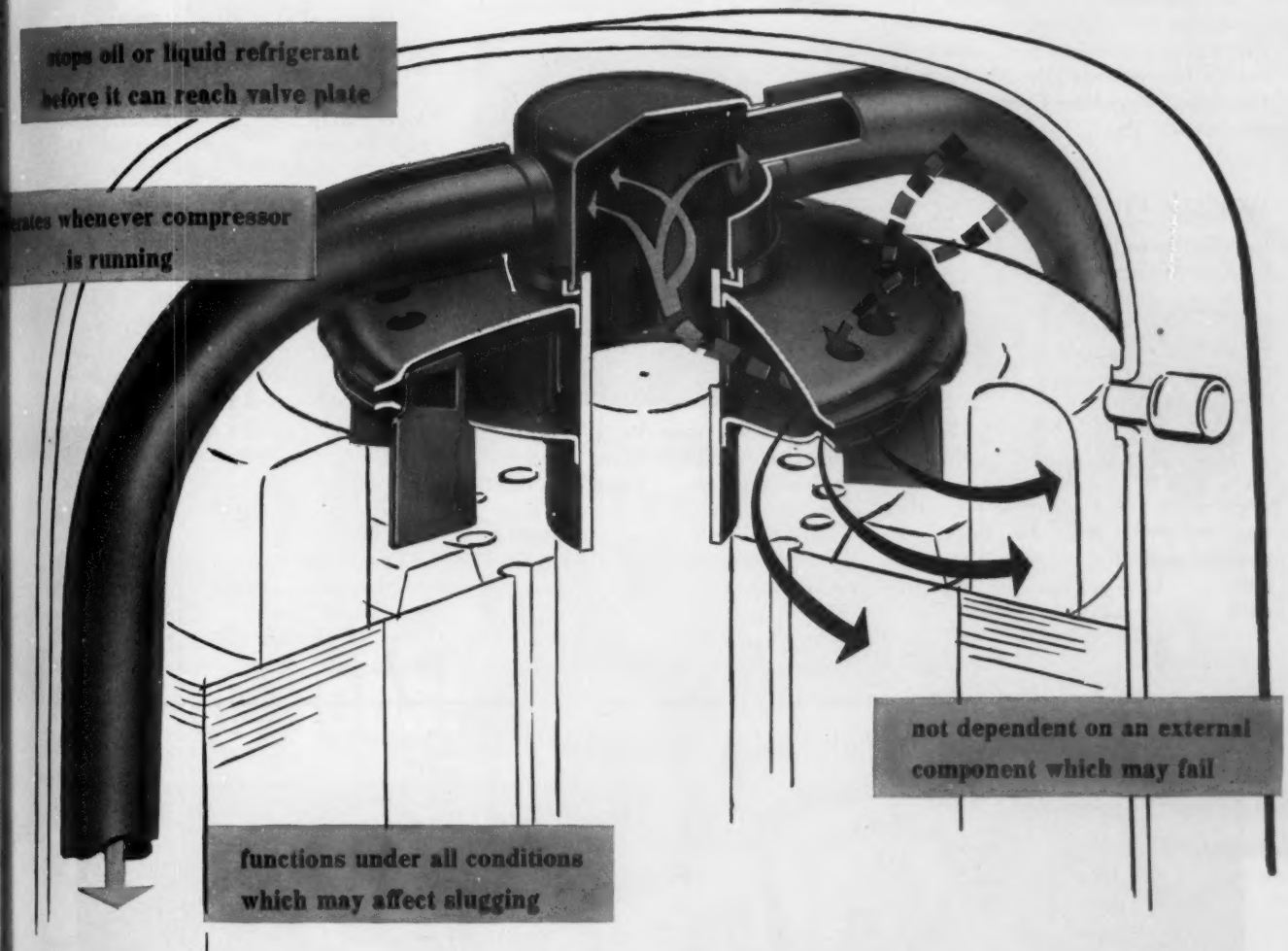
BELLOWS METER

Typical of applications for which this mercuryless meter is designed are those for indicating steam, air, gas and water volume of industrial proc-



esses and side streams or cuts from fractionating towers. Fifteen different ranges from 0-20 to 0-400 in. of water are available and can be changed

TECUMSEH'S exclusive *NEW* ANTI-SLUGGING *FEATURE*


stops oil or liquid refrigerant before it can reach valve plate
rates whenever compressor is running
not dependent on an external component which may fail
functions under all conditions which may affect slugging

The new Tecumseh Anti-Slug Device consists basically of two assemblies. One is the centrifuge which is press-fit on the crankshaft and therefore rotates at the speed of the compressor. The suction of the piston pulls in the refrigerant and oil mixture in the dome through the holes on top. The paddles help in breaking up this mixture and the liquid refrigerant and oil are expelled through the slots by centrifugal force. The gas, being lighter, is drawn through the slots in the hub. The second assembly is merely a collection pan which has two tubes leading to the cylinder heads and the valves. This assembly is stationary and fits over the hub of the centrifuge, directing the gas to the cylinders. With a normal charge, little if any oil or liquid refrigerant reaches the valves, thus greatly minimizing the possibility of slugging. This exclusive feature is one more example of industry progress made possible by Tecumseh engineering advancements.

forty million compressors in the field

TECUMSEH

TECUMSEH

MARION, OHIO
TECUMSEH, MICHIGAN

PRODUCTS COMPANY

FOREIGN OPERATIONS DIVISION: Tecumseh, Michigan

CANADA: Tecumseh Products of Canada, Limited, 1667 Dundas St., London, Ont.

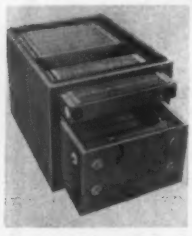
in the field by substituting spring assemblies of the desired range.

Calibrated accuracy is ± 1% full scale for ranges of 0-50 in. of water or above and ± 1¼% full scale for ranges below 0-50 in. of water. Standard scale calibrations are 0-100 linear or 0-10 and 0-100 sq root with other graduations available on request. Features include: hysteresis ± ¾%; ambient temperature limits –40 to 175 F; compensations for ambient temperatures; linear damping adjustment and seamless stainless steel bellows.

Brown Instruments Div, Minneapolis-Honeywell Regulator Company, Philadelphia 44, Pa.

1960 AIR FILTERS

Installed in forced air ducts, this electrostatic filter requires no plumbing or drainage lines. As air passes through the filter, the charging section gives dirt and other particles a positive electrical charge. These particles are then attracted and held by negatively-charged collector plates. The entire collector section can be removed easily for cleaning.

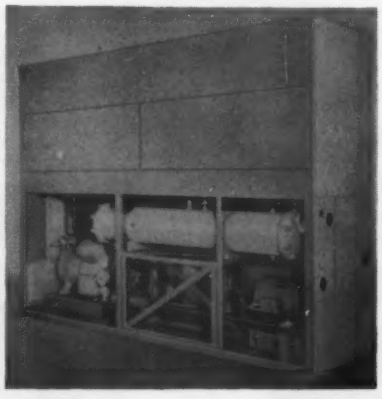


Three models, 22 x 20 x 21, 22 x 24 x 26 and 22 x 24 x 29 in., respectively, in 115 volt capacities, comprise the 1960 line.

York Div, Borg-Warner Corporation, York, Pa.

MULTI-ZONE UNITS

Nominal 25, 30 and 40-ton sizes of packaged multi-zone air conditioners in this new line are available with air handling capacities of 10,200, 12,600 and 17,100 cfm, respectively.



Conditioners may be purchased as either single-zone basic (shown) or multi-zone units. Choice of either top horizontal or up-blast discharge is available with single-zone units, which may be equipped with a steam or hot water heating coil for off-season or winter heating.

Multi-zone units are also available with top horizontal or up-blast discharge. This design features an assembly in which the heating coil is mounted in either of two arrangements available. Compressor construction includes integral capacity control system, automatically reversible oil pump and crankcase heaters. The filter-drier is of the full-flow replaceable cartridge type. Evaporators are multi-circuit type with copper tubes and aluminum fins. One and two-row steam or hot water heating coils are available. Filter boxes (optional) are attached to the air inlet side of the units. Units are available for use on 220 or 440 volt.

American Radiator & Standard Sanitary Corporation, Industrial Div, Detroit 32, Mich.

GAS-FIRED FURNACES

Four sizes of gas-fired, upflow furnaces in a compact design are being offered in this line. Dimensions of the units are 51 in. high, 26 in. deep and widths varying from 14 to 20 in. They can be used in a year-round air conditioning system by coupling them with a self-contained cooling and dehumidifying unit. Input capacities are 70,000, 80,000, 100,000 and 120,000 Btu/hr.

Quiet, direct-drive blowers are adjustable to three speeds by a wiring change on the tap-wound motor to vary air quantity. Both furnace and cooling unit blower operate to deliver

WHEN THE LIFE MEMBERS MET IN DALLAS

Here are some ASHRAE Life Members and guests as they attended a special luncheon on February 2 during the Dallas Semiannual Meeting. 4—H. A. Whitesel, 5—R. W. Roose (guest), 6—W. A. Danielson (guest), 7—L. S. O'Bannon, 8—C. McConner, 9—A. F. Barnes, 10—E. K. Campbell (Secretary), 11—W. E. Gray, 12—R. P. Schoenijahn, 13—W. L. Lynch, 14—C. H. Flink, 15—A. Walters, 2—F. C. McIntosh (guest), 3—M. F. Rather, 1—A. V. Hutchinson (ASHRAE Secretary Emeritus), 18—G. H. Cummins, 19—W. M. Wallace, 11 (guest), 17—H. E. Adams, 16—I. C. Jennings.

one thermostat unit handles 12 different heating and cooling jobs!

APPLICATION	FAN SELECTOR SWITCH	SYSTEM SELECTOR SWITCH
HEATING ONLY	—	—
	—	AUTO-OFF
COOLING ONLY	—	—
	—	AUTO-OFF
	AUTO-ON	AUTO-OFF
	AUTO-ON	—
COOLING — with system interlock for separate heating thermostat	—	HEAT-OFF-COOL
	AUTO-ON	HEAT-OFF-COOL
COMBINATION Heating-Cooling	—	HEAT-COOL
	AUTO-ON	HEAT-COOL
	—	HEAT-OFF-COOL
	AUTO-ON	HEAT-OFF-COOL

PENN RIMSET REDUCES YOUR CONTROL INVENTORY

Why carry a large inventory of room thermostats when ONE unit . . . the Penn "RIMSET" . . . will control any heating-cooling function desired? You just stock variables of the subbase . . . the same thermostat simply plugs onto any one of these subbases!

And, here's another extra . . . the Penn "RIMSET" is today's easiest-to-set, easiest-to-read thermostat. When setting temperature, simply *dial the rim* . . . the extra large dial face *remains stationary!* Once you use this better thermostat, you'll want it on all of your heating and cooling installations. Try Penn on your next job!

PENN CONTROLS, INC. Goshen, Indiana

EXPORT DIVISION: 27 E. 38th ST., NEW YORK, N.Y.

AUTOMATIC CONTROLS FOR HEATING, REFRIGERATION, AIR CONDITIONING, APPLIANCES, PUMPS, AIR COMPRESSORS, ENGINES

the larger quantities of air often needed for summer cooling. In winter, the furnace fan alone operates and air by-passes the cooling unit.
Carrier Corporation, Syracuse 1, N. Y.

THREE FREEZERS

Three cu ft capacity in the fast freezing compartment and a counter-balanced lid are features of the 15.3 cu ft chest freezer in this line. Also noted are a door lock and thin wall construction incorporating glass fiber insulation.

A deluxe step-up model is offered with an additional removable frozen storage basket, protected interior light and warning signal light that turns off automatically if the freezer should need attention.

Introduced as a matching unit for two new Dual Temp refrigerators is a 16.2 cu ft upright freezer with a capacity of 539 lb of frozen food. Features include four double grid freezing surfaces, built-in door lock, thin wall construction and a new power plant. Freezer can be placed flush against a wall since the condenser has its own system for air circulation.
Admiral Corporation, 3800 Cortland St., Chicago 47, Ill.

VALVE LINE

Designed for charging, purging and many other industrial uses, this general purpose valve line meets the need for panel mounting. Features include forged brass bodies, easy-to-grip handles and Teflon packing and seats for positive leakproof shut-off without stress or strain.

Madden Brass Products Company, Aurora, Ill.

WATER-TO-AIR HEAT PUMP

Heating capacities range from 49,000 to 206,000 Btu/hr for pumps in this line, which are available in five sizes from three, five and seven and one-half-ton single compressor units to ten and fifteen-ton dual compressor models.

Providing year-round temperature control is a heating and cooling thermostat, and an integrally-mounted temperature control panel with selector switch for heating and cooling changeover is standard on the three smaller models. Controls consist of separate heating and cooling expansion and water regulating valves, magnetic starters, pressure and temperature cutouts and reset relay. The control circuit is supplied from a low voltage transformer. Standard on the ten and fifteen-ton models is a remote, wall-mounted thermostat which is optional on the smaller units. Larger, dual refrigeration model controls consist of a combination of low voltage heating and cooling, two-stage thermostat and selector switch for automatic changeover.
Trane Company, La Crosse, Wisc.

PORTABLE AIR PURIFIER

Available in three portable models with capacities of 100, 200 and 500 cfm for room sizes from 10 x 10 to 25 x 25 ft, this fan circulates room air through both an activated charcoal and germ-killing Fram filter. The only connection required is a standard 110-volt ac outlet. Models are also offered for flush wall installations.
Manesco, Inc., 605 Plandome Rd., Manhasset, N. Y.

GAS REFRIGERATORS

Three models introduced recently are combination refrigerator-freezers 13 cu ft in size and are no-frost models. A new air circulation system directs cold air through ducts in a shelf with the result that items placed on this shelf chill as much as three times faster than in ordinary units. A combination of constantly circulated cold air and placement of coils outside the refrigerator and freezer food compartments eliminates frost accumulation completely. Outside dimensions have

been reduced sizeably through use of urethane foam insulation in the units, while permitting increase of 21% in food storage space.
Whirlpool Corporation, St. Joseph, Mich.

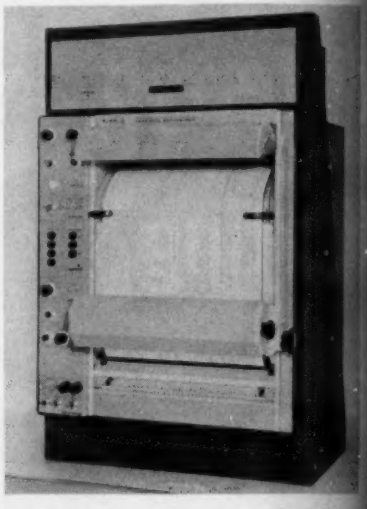
SILENCERS

Redesigned, Quiet-Duct Silencers feature a bell-mouth entrance for min entrance loss of a solid nose entrance for max noise reflection. Other features which provide extensive noise reduction with low pressure drop are a narrow throat passage for impedance combined with a straight throat passage for min air friction. Diverging design of the evase exhaust keeps turbulence low and allows for min pressure regain.
Industrial Acoustics Company, Inc., 341 Jackson Ave., New York 54, N. Y.

OSCILLOGRAPH RECORDS

"Dataflash," a technique cited providing oscillograph records in less than one sec, is available with Type 5-123 Modular Oscillograph and is interchangeable with the standard record drive module of the instrument.

Involved in this technique is raising the temperature of the oscillogram

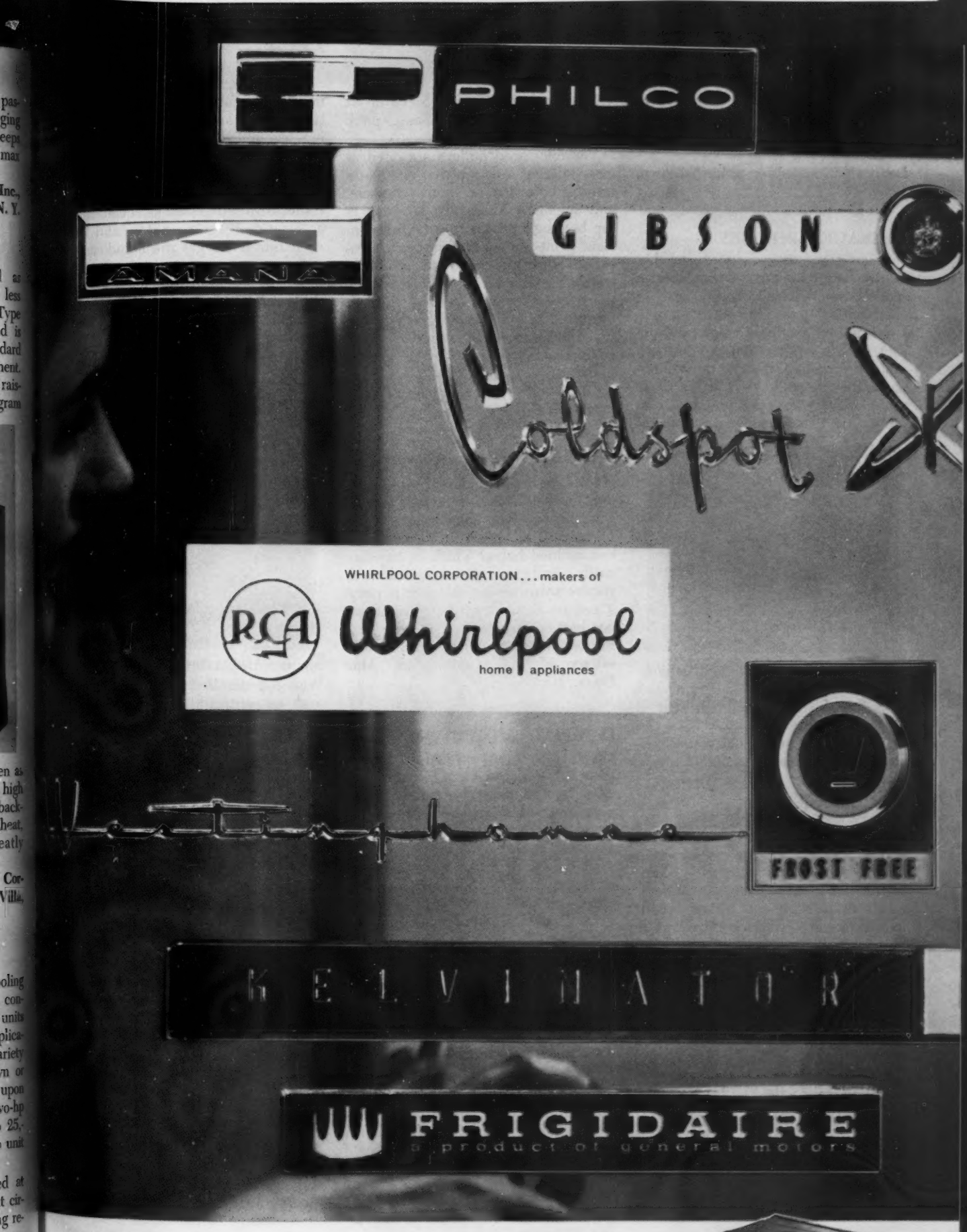


by passing it over a heated platen as the latent image is recorded by a high energy light. Formation of the background fog is stopped by the heat, while image recording is greatly speeded.
Consolidated Electrodynamics Corporation, 360 Sierra Madre Villa, Pasadena, Calif.

CONDENSING UNITS

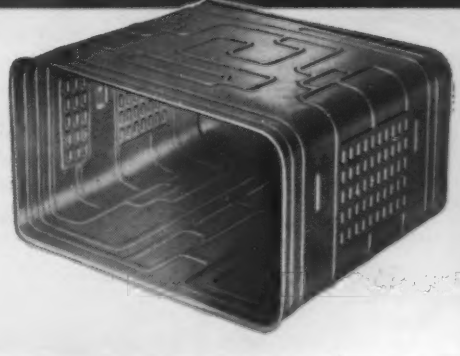
Delivering a min eight Btu cooling per watt of power input to the condenser, these two and three-hp units for remote air conditioning applications can be used with a wide variety of evaporator coils for up, down or horizontal air flow. Depending upon evaporator coil selected, the two-hp unit will deliver from 22,000 to 25,000 Btu/hr cooling, the three-hp unit from 33,000 to 40,000.

Coil has been pressure tested at 400 psi. It has a new refrigerant circuiting method cited as increasing refrigerant sub-cooling, thereby producing more cooling per watt. Air mover is an axial flow fan and compressor is suction-cooled, resiliently mounted, overload protected and has a crankcase heater to prevent liquid slugging caused by cold start-ups. Other standard equipment includes a



Look who's cooling with ~~ROLL-BOND~~

evaporators by Olin



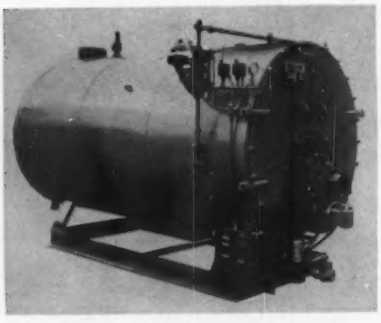
OLIN MATHIESON METALS DIVISION, East Alton, Illinois

Producers of: Roll-Bond, Western Brass and Olin Aluminum

liquid charge indicator, replaceable drier, gauge ports and 24-volt mercury bulb thermostat for cooling and heating.
Lennox Industries Inc., Marshalltown, Iowa.

PACKAGED BOILERS

In sizes from ten to 125 boiler hp, Husky Series boilers are available in models for light oil, natural gas or combination gas-light oil operation. Units are of compact three-pass design, with a single motor driving both fan and oil pump. Forced draft eliminates the necessity for tall stacks or other auxiliary draft equipment. Operating and flame safeguard controls



are standard in an enclosed cabinet. Low-fire start is standard, but full modulation on both oil and gas is available.
Western Boiler Company, 47 Rousseau St., San Francisco 12, Calif.

REFRIGERANT VALVE

Hand-wheel operated, this refrigerant cylinder valve will be used on all Ucon Refrigerant cylinders. Elimination of adjustments and replacements of packing and leakage problems common to chlorine valves is due to packless diaphragm design. Retained in this redesigned valve is use of naval brass as the structural material for the valve body and Duronze alloy in the spindle, and positive safety features of a fusible poured metal alloy plug.

Interchangeable on the 10, 25 and 145-lb cylinders, the valve is protected by ring-top design on the 10 and 25-lb units and, on the 145-lb cylinder, it fits under and is protected by a conventional transit cap.
Union Carbide Chemicals Company, Div of Union Carbide Corporation, 30 E. 42nd St., New York 17, N. Y.

VARIABLE-SPEED SHEAVES

Two additional sizes of MS variable-speed sheaves bring the number of models in this series to seven, covering a range from two to 15 hp. New additions are MS-100-10 (ten hp at 1750 rpm) and MS-100-15 (15 hp at 1750 rpm). Both have max pitch diams of ten in.

Variable-speed pulleys are cited as incorporating a design that eliminates fretting corrosion as well as freezing and sticking. There are no keys in the bearing surfaces to establish constant point-contact and obstruct lubrication. Instead, a series of torsionally resilient rubber keys located outside the bearing surfaces transmit the belt torque. Sheaves are designed for use with angled motor bases and V-groove companion sheaves to provide a V-to-V drive.
T. B. Wood's Sons Company, Chambersburg, Pa.

PIPE-FITTING INSULATION

Fit-rite, a molded glass fiber insulation for standard pipe fittings, is now available in four thicknesses: ½, 1, 1½ and 2 in. Each fitting comes in two molded halves which fit together easily, and may be installed with staples, soft wire or tape; once in place it can be finished with canvas or vapor barrier casings.
Fibrous Glass Products, Inc., a subsidiary of Pall Corporation, Alpa Plaza, Hicksville, N. Y.

DAMPING COMPOUND

When sprayed or troweled onto metal plate, this viscose-elastic material is cited as reducing structurally borne noise and vibration and as rendering metal plate acoustically equivalent to a sheet of cork. Vibrodamper compound is handled like a coat of paint, dries to a smooth finish, is non-toxic and non-flammable, resists alkali, grease, gasoline and aliphatic oils, and is unaffected by ozone or sunlight.
Korfund Company, 48-53D 32nd Pl., Long Island City 1, N. Y.

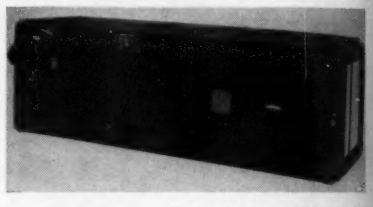
THREE-STAGE PACKAGE

Typical applications of this three-stage rotary booster package (it has an insulated cooler which produces −92 F with methanol) include frozen food warehouses, low temperature test chambers and brine cooling for dairy, drug, chemical and petrochemical industries. Designed for use with Refrigerant 12, the unit is factory assembled in two sections, simplifying field installation.

One of the two sections consists of an intermediate stage FES-Fuller rotary booster driven by a 40-hp motor and a high stage reciprocating compressor, also driven by a 40-hp motor. Included in this section are a water-cooled condenser refrigerant gas and liquid intercooler, automatic oil return system and interconnecting piping assembled, tested and insulated before shipment. Comprising the other section are a low stage, 40-hp, FES-Fuller rotary booster, methanol cooler with refrigerant level controller, automatic oil return system and low-stage refrigerant gas and liquid cooler, with interconnecting piping assembled, tested and insulated before shipment.
Freezing Equipment Sales, Inc., York, Penna.

HORIZONTAL FURNACES

Designated Models No. OY-90-E (89,600 Btu input), OY-106-E (106,400 Btu output) and OY-124-E (123,200 Btu output), these three new oil horizontal furnaces feature increased air handling capacities for addition of a



summer air conditioning cooling coil. With the standard equipment blower and an optional higher capacity blower motor, they will handle up to three, four and five ton of cooling, respectively.
Henry Furnace Company, Medina, Ohio.

POWER ROOF VENTILATORS

Specially designed for high-capacity duct and flue exhaust applications, four new centrifugal power roof ventilators have been added to the L-CRF line, increasing capacity in this line from 11,000 to 29,790 cfm.

Fan motor in these units is direct-connected to an air-foil-type fan which eliminates belt maintenance and friction loss due to belt slippage.
Ilg Electric Ventilating Company, 2850 N. Pulaski Rd., Chicago 41, Ill.

BUILT-IN UNION

Added to this manufacturer's line of industrial thermostatic steam traps, this model is equipped with a union incorporated into the trap and cited as reducing both initial cost and maintenance. Designed into the inlet of the trap, the union eliminates time involved in fitting pipe to a union, as well as the cost of purchasing a separate union and materials.
V. D. Anderson Company Div, International Basic Economy Corporation, 1935 W. 96th St., Cleveland 2, Ohio.

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Balancing cost factors and advantages of an Air-recovery system against conventional air conditioning

Economically speaking, there are two arguments to justify the adoption of a new engineering concept: it either offers the same service for less cost, or it offers greater advantages for the same cost.

The economic justification for an air-recovery system rests on the latter. (For the purposes of this paper, an air-recovery system is defined as a high-efficiency electronic air cleaner teamed with an activated-charcoal air filter.) The original cost of such a system is comparable to a conventional air-conditioning system, for the air-recovery system requires less air-conditioning equipment, because it cleans and deodorizes air that already has been heated or cooled instead of bringing in large quantities of outside air which would have to be raised or lowered to the desired temperature. Operating costs are approximately equal with the advantage lying with the air-recovery system.

But there are other benefits with an air-recovery system . . . the client gets increased cleanliness, reduced cleaning and decorating expenses, improved production with fewer rejects (as in the case of a food-processing plant or a precision-manufacturing facility). . . . Depending on the individual situation, these advantages may far outweigh a strictly economic analysis based on original and operating costs.

JOHN E. HAINES
Presidential Member
ASHRAE

It is important that the electronic air cleaner and the charcoal filter be considered as a unit. Without the electronic air cleaner, which removes 90 per cent or more of particulate matter 0.01 micron diam and larger, the tiny passages of the charcoal filter would become choked with dirt, rendering it useless. Without the activated-charcoal filter, the air-recovery system would remove dirt all right, but it would not remove odor molecules. Therefore additional outside air would have to be brought in to dilute odors, and this would obviate any potential economic advantage of the system.

Mechanics of an air-recovery system (Fig. 1) are simple. Air, at velocities to 500 fpm, first passes through a 13,000-volt electrostatic field, putting a positive electrical charge on each dirt particle. Next the air goes between collector plates which carry 6500-volt positive and negative charges. The positively charged dirt particles are repelled from the positively charged plates and attracted to the negative plates. At 500 fpm, an electronic air cleaner can remove 90 per cent of particles 0.01 micron and larger; at lower velocities the cleaner eliminates over 95 per cent of these particles. (Percentages are from the National Bureau of Standards dust-spot tests.)

The NBS dirt-removal test is used because it reflects the dirt-removing properties of various air cleaners. As the NBS report[1] says: "Dust particles may be divided into two categories: coarse and fine. Coarse particles are those which are deposited by gravity on horizontal surfaces. Fine particles are those which are deposited on walls and ceilings, independent of gravity. It has been determined that the coarse particles contribute practically all of the weight of a dust mixture, while the fines contribute practically all of the number of particles in a dust mixture.

"If, therefore, a weight method is used to determine filter arrestance, almost any mechanical filter could be designed to obtain arrestances of 95 per cent or better, although the number of fine particles would not be materially reduced.

"Since it is noticeable that the fine particles cause most of the discoloration problem in buildings, the arrestance of such a filter would approach zero in combating discoloration. A filter test based solely on determination of weight re-

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[1] page 11, Technical Report 34, National Academy of Sciences—National Research Council.

moval is of little value when selecting a filter for air distribution in conditioned spaces. The discoloration test or dust-spot method is the only acceptable method of testing filters presently in use.

"One of the major reasons for filter tests is to compare the various types of filters. The NBS 'Dust-Spot Method' allows an intertype comparison of filters which can be conducted using the same apparatus and any of the nonliquid aerosols. These tests definitely show the differences between filters of different types, as well as between filters of the same type operating under the same conditions."

While an electronic air cleaner will remove dirt in the air, it cannot, however, eliminate molecular odors and gases. Basically, there are two ways to get rid of an odor — it can be chemically "masked" or it can be eliminated. Masking may reduce the odor sensation but since it does not remove odor molecules, it does not remove whatever additional deleterious properties they may have.

The most efficient and economic way to eliminate odor molecules is with an activated-charcoal filter. Because of its unusual microscopic structure, charcoal has the property of adsorbing vast quantities of odor-producing molecules. Each granule of charcoal contains millions of tiny capillary passages. The area of these passages is extremely large (estimated at over 6 million sq ft in a single pound).[2] Here in this inner surface area charcoal removes odor molecules two ways: by surface adsorption and by capillary entrapment in the narrowing passages of the charcoal. Surface adsorption is the attraction charcoal has for molecules of gases and vapors.

The amount of an odor-producing substance required to create a noticeable sensation is extremely small, often less than 1 in 1 million parts of air. Therefore, odor-removal must be fairly complete to be effective. Starting with an overpowering odor, such as hydrogen sulfide, removing 99 per cent of the odor molecules still leaves a definite odor; removing 99.9 per cent of the molecules still leaves a perceptible odor.

It is by eliminating odors that

[2] Air Conservation Engineering, Amos Turk.

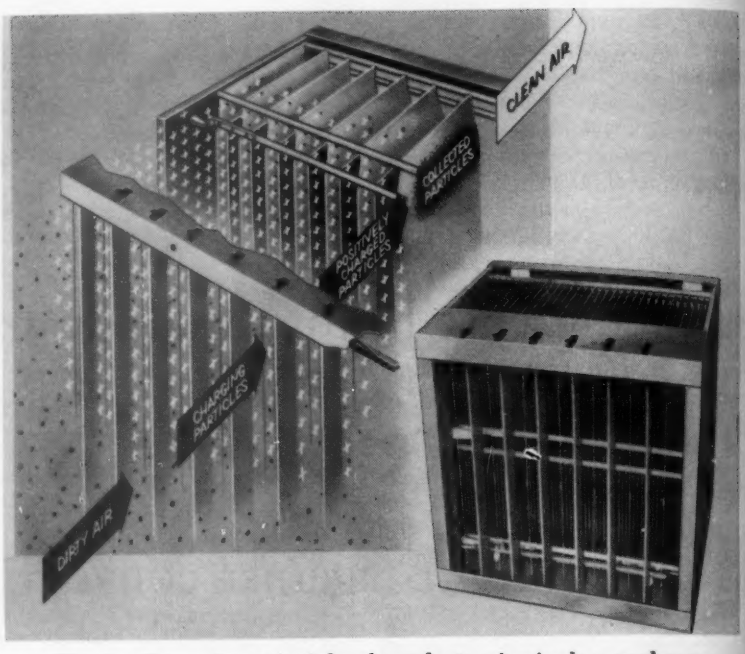
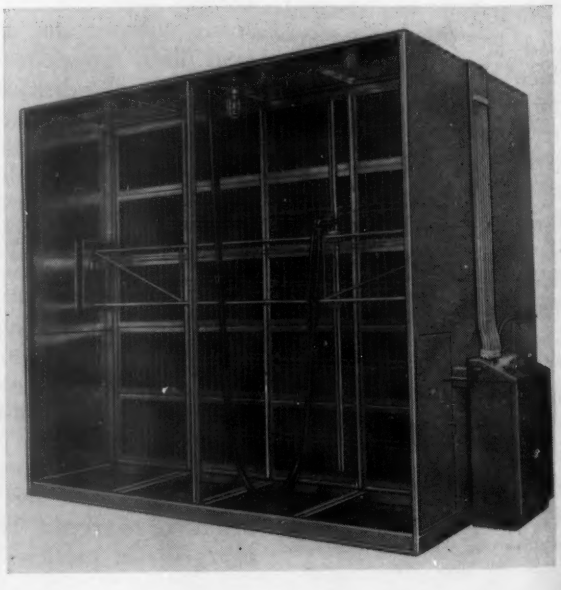


Fig. 1 Operating principle of an electronic air cleaner shows why its cleaning efficiency greatly exceeds that of ordinary mechanical filters. Air flowing into the cleaning cell first passes through the ionizer. Here all dirt particles, no matter how small, are given an electrical charge. They are then carried by the air into the cell's collector unit, where parallel plates of opposite electrical charge attract and hold particles, just like a magnet collects iron filings

Fig. 1A Face of electronic air cleaner, photographed before installation, shows how cells join together like building blocks, forming a single unit sized to the air handling system. The traveling washing manifold (with hoses attached) normally rests at the side of the cleaner, out of the airstream. When washing starts, the manifold moves across the cells and cleans them with water sprayed from its nozzles. A second set of nozzles then sprays adhesive into the cells. In the next washing, the adhesive dissolves readily in the water spray and carries all collected dirt from the cell



cost of an air-recovery system becomes compatible with a conventional air-conditioning system. A conventional air-conditioning system with a mechanical filter does not eliminate odors; instead it dilutes them by adding vast quantities of outside air. This outside air must be either heated or cooled to a required temperature, meaning extra heating or cooling capacity. By reducing need for this excess heating and cooling capacity, an air-recovery system can be economically competitive with a conventional system.

TABLE I—TYPICAL OPERATING COSTS COMPARED

LINE	CONVENTIONAL AIR-CONDITIONING SYSTEM	PROPOSED AIR-RECOVERY SYSTEM
1 Building area	120,000	120,000
2 Outside ventilating air required (1957 Chicago code)	24,000	10,800
3 Tons of cooling capacity required	60.5	27.2
4 Cost of cooling capacity	$18,313.35	$8233.44
5 Cost of filter equipment	$8400	$19,270
6 Cost advantage of conventional system	$790	
7 Operating cost of cooling required ventilating air	$687.89	$309.26
8 Operating cost of heating required ventilating air	$1191.36	$536.11
9 Operating cost of filters	$900	$1052.43
10 Total operating costs	$2779.25	$1897.80
11 Annual cost advantage of air-recovery system		$881.45

ORIGINAL COSTS

To compare cost advantages of an air-recovery system with a conventional installation, assume a 120,000-sq-ft office building to be built in the Chicago area. The accompanying figures (Table I) are averages and may not reflect conditions throughout the country. However, the figures are on the conservative side and are weighed against the air-recovery system. It is probable that an engineer may find definite savings for a given building. The results, of course, will differ, depending on the building, local conditions, area economy and other factors. To determine whether or not an air-recovery system will be beneficial economically must be left to the engineer's professional judgment.

The 1957 Chicago code provides for reduced ventilation requirements when an activated-charcoal filter is used. With a conventional air-conditioning system 0.2 cfm of outside air per sq ft of building area would be required for the given office building (line 2) while the proposed air-recovery system would reduce the code requirements by more than half – to 0.09 cfm a sq ft or 10,800 cfm, saving 13,200 cfm of heating and cooling capacity otherwise needed if outside air were used.

Summer design conditions for Chicago (from the 1959 ASHRAE GUIDE, Table II, page 171) are outside temperatures of 95 F dry bulb and 75 F wet bulb and indoor temperatures of 80 F dry bulb and 67 F wet bulb. Cooling the outside air this much takes 30,300 Btu an hr for each 1000 cfm (page 197, 1959 ASHRAE GUIDE). Since 1 ton of cooling capacity will remove 12,000 Btu an hr (page 5, 1959 ASHRAE GUIDE) it would take 2.52 ton to cool 1000 cfm of Chicago summer air. The air-recovery system saves 13,200 cfm or 33.3 ton of cooling capacity (line 3).

Typical installed cost for a ton of cooling equipment is $302.70 (from the 1959 ASHRAE GUIDE, Table I, page 728, adjusted by current building cost index, with cooling tower at $54). Since 33.3 fewer tons are required, installed air-conditioning equipment savings are $10,079.91 (line 4).

Cost of an electronic air cleaner to handle 120,000 cfm – at 14 cents per 1000 cfm including freight and installation – is $16,800 (based on National Academy of Sciences–National Research Council figures, adjusted to 1960 levels).

In addition, cost of the activated-charcoal filter must be included. Figuring the amount of air to be treated at 13,200 cfm (to equal 24,000 cfm of outside air), initial cost for 13 filters (at $190 installed including baffles) would be $2470. Total cost of the air-recovery system is $19,270 (line 5).

This is partially offset by installed cost for a conventional automatic self-renewing fibrous curtain air filter–$1400 for a 20,000-cfm unit including freight and erection (from National Academy of Sciences – National Research Council figures). In this example six such units would be required, for a total of $8400. Adding the costs shows the air-recovery system costs $790 more than a conventional system (line 6).

The cost, of course, depends on the size of a building. As the size increases, the savings of installed air-conditioning equipment mount, tending to favor the air-recovery system. For a smaller building, the converse is true, and the cost difference for the proposed air-recovery system will assume a larger proportion of the amount for air-handling equipment. However, any negative balance is offset by operating savings.

OPERATING COSTS

During a Chicago summer there will be 620 hr of full-load air-conditioning operation (1959 ASHRAE GUIDE, Table V, page 730). To operate 60 ton of air-conditioning equipment costs 1.5 cents a ton an hr (based on Carrier Corporation data). Therefore, cost of each operating ton during the 620 summer hours would be $9.30.

Water costs are figured at 32.8 cents a ton a year (page 95, Modern Air Conditioning, Heating and Ventilating by Carrier, Cherne and Grant). Annual repairs, refrigerant and lubricants cost for each ton is $1.738 (based on 1959 ASHRAE GUIDE, Table IV, page 729, adjusted for 1960). Total for power, water and supplies is $11.37 a ton each year. Operating cost for the 60.5 ton cooling capacity of the conventional system is $687.89, compared to $309.26 to operate cooling equipment for the air-recovery system (line 7).

Average Chicago winter temperature is 37.6 F (1958 ASHRAE GUIDE, Table I, page 263). Operating the building 55 hr a week for the 31 weeks from October through April would total 1705 hr.

To heat 1000 cfm of 37.6 F air to 70 F takes 35,000 Btu an hr (1959 ASHRAE GUIDE, formula 5, page 144). For the 1705 hr of winter weather the heating system would

require 59,675,000 Btu per 1000 cfm.

Figuring natural gas at 1021 Btu a cu ft (Table VI, page 475, 1959 ASHRAE GUIDE) the boiler needs 58,400 cu ft to heat 1000 cfm during the 31-week winter season. If the gas rate is 85 cents a cu ft, it costs $49.64 to heat this 1000 cfm. Heating costs for the conventional system are $1191.36. Since an air-recovery system would save 13,200 cfm, heating costs for this system are $536.11 (line 8).

Annual operating costs for a conventional automatic self-renewing fibrous curtain air filter (using National Academy of Sciences–National Research Council figures) would be: labor (8 hr at $3), four rolls of media (at $30 each) and current ($6) to total $150 for a 20,000 cfm unit. For six such units the annual operating cost would be $900 (line 9).

Operating costs for an air-recovery system (from National Academy of Sciences–National Research Council figures) include two rectifiers (at $15 each), 10 gal of oil (at $1 a gal) and 24 hr of labor at $3, plus $13 for current to total $125. Since this is for one 20,000 cfm unit, cost of operating six such units yearly is $750.

In addition, the electronic air cleaner will require regular washing. In this example the cleaner is 7 cells high and 19 ft wide. Each cell tier requires 6¼ gpm, or 44 gpm for this installation. Complete washing takes 30 sec for each ft, or a total of 10 min for the 19-ft-wide equipment. With 44 gpm used for 10 min, the total requirement for each washing cycle is 440 gal. Washing the unit every 2 weeks requires 11,440 gal a year. Figuring water at 90 cents for 1000 gal, annual water cost is $10.30.

To heat this water from 40 F to the required 140 F takes 1.66 cu ft of gas for each gal. Total gas required each year then is 18,900 cu ft. At 85 cents per 1000 cu ft, annual water-heating cost is $16.14. Total washing water costs are $26.44 annually.

Operating costs (labor, freight, recharged cells) for an activated-charcoal filter come to $21.23 for 1000 cfm or $275.99 for this example. Total annual operating costs are $776.44 plus $275.99 or $1052.43 (line 10). Therefore, initial cost of an air-recovery system is more than offset during the first year. After that, operating savings are around $900 a year in the example (line 11).

But economic justification of an air-recovery system is based on more than original and operating cost comparisons. While these costs may be roughly equal to a conventional system, an air-recovery system will also add other benefits.

While many of these advantages have a measurable economic value, others, though desirable, cannot be assigned a definite dollar cost. For these the engineer and his client must consider the benefits on a subjective basis.

The economic advantages of clean air may take many forms: fewer rejects in a food-processing plant; lowered possibility of infection in a hospital; lessened cleaning expense in a commercial building.

- a midwest bank pays out $175,000 annually for interior cleaning . . . including $12,500 for washing windows on the inside, $10,000 for cleaning walls so they can be repainted. Clean air would obviate much of this expense.
- department stores write off up to $500,000 annually for soiled merchandise, even when dustcovers cover counters every night.
- an exhaustive study by the Building Owners and Managers Association shows over 54 cents a sq ft yearly is spent just to keep office areas clean enough for occupancy. (This 54 cents is 23 per cent of the entire operating cost for office buildings.)

Unclean air costs money in many ways not so directly traceable. A portion of absentee losses,

TABLE II—TYPICAL ANNUAL OWNING AND OPERATING COSTS A SQUARE FOOT

	OFFICES	HOSPITALS	FACTORIES	HOTELS	STORES	SCHOOLS	COLLEGES
1 Building Cost	$ 2.91	5.56	1.92	3.47	2.25	2.21	2.41
2 Operating Equipment, Utilities and Supplies	$ 2.	19.80	7.05	1.90	4.	.32	.23
3 Cost of Year-Round Air-Conditioning System	$ .518	.707	.418	.797	.368	.221	.258
4 Air-Recovery System Owning Cost	$ .0161	.0161	.0161	.0161	.0161	.0161	.0161
5 Air-Recovery System Operating Cost	$ .00874	.01991	.00871	.01991	.00908	.00391	.00814
6 Air-Recovery System Owning & Operating Costs	$ .025	.036	.025	.036	.025	.022	.024
7 Cleaning & Decorating Costs	$ .545	1.09	.299	.919	.545	.426	.449
8 Per Cent Reduction in Cleaning & Decorating Costs Required to Pay for an Air-Recovery System	4.6	3.3	8.3	3.9	4.6	5.2	5.4
9 Salaries & Wages (including Fringe Costs)	$66.00	26.94	36.10	3.42	10.00	6.52	7.15
10 Per Cent of Absenteeism	2.72	2.8	3.4	2.72	2.72	3.14	2
11 Salaries & Wages or Work Time Lost Because of Absenteeism	$ 1.80	.754	1.23	.093	.272	.204	.143
12 Per Cent Reduction in Absenteeism Required to Pay for an Air-Recovery System	1.4	4.8	2.0	38.7	9.2	10.8	16.8
13 Per Cent Reduction in Absenteeism & Cleaning & Decorating Costs to Pay for Air-Recovery System	1.1	1.9	1.6	3.5	3.1	3.5	4.1

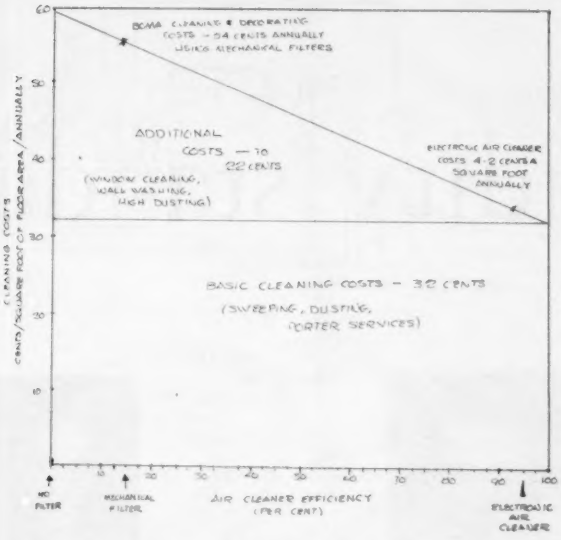


Fig. 2 How variable costs are reduced when the air is cleaned (BOMA)

lowered or inferior production – as well as decreased lighting efficiencies, periodic air-duct cleaning, objectionable tobacco smoke and other subordinate costs – must be charged to air-borne dirt, which could be eliminated.

Air-conditioning engineers have developed a worksheet (Table II) to compute the potential savings using an air-recovery system for seven major classes of buildings – offices, hospitals, factories, hotels and motels, department stores, schools and colleges.

In this worksheet only savings from reduced cleaning and decorating expenses and reduced absenteeism are figured. For specific buildings there probably will be additional savings that will be even greater than these. Such savings depend on the individual building use (a food-processing plant needs to be cleaner than a foundry) and therefore the total potential savings.

Line 1 is cost of a typical building on an annual sq-ft basis, amortised over 40 yr at 5 per cent interest, with 1 per cent set aside for insurance and an additional 1 per cent for taxes. Cost figures are based on U. S. averages.

Line 2 is the cost of operating equipment, utilities and supplies required for each type of building, again on a yearly sq-ft basis. Note that costs range from 23 cents for a college building to $19.80 for a typical hospital – a spread of 8700 per cent!

Line 3 shows the installed cost of a quality year-round air-conditioning system, amortised over 20 yr at 5 per cent, with 1 per cent set aside for taxes. This figure includes regular maintenance of the system.

Line 4 is the cost of an air-recovery system, again on an annual sq-ft basis, amortised over 20 yr at 5 per cent, with 1 per cent for taxes and 1 per cent for insurance. While exact cost will vary with the volume of air required, in no cases should it go over these generous estimates.

Line 5 – operating costs of an air-recovery system – depends on the type of building and the number of hours the system will be in operation each day. Figuring power, cleaning labor, hot water, adhesives, parts, maintenance and the hours of operation (ranging from 1665 annually for a school to 8760 for a hospital), costs range from just over half a cent to nearly 2 cents on an annual sq-ft basis.

Line 6 – owning and operating costs (found by adding lines 4 and 5) are also on an annual sq-ft basis. Again, these costs are liberal estimates and in practice engineers will find costs for specific buildings are lower.

CLEANING AND DECORATING EXPENSES

Line 7 shows typical cleaning and decorating costs on an annual sq-ft basis, taken from experience exchange reports from the Building Owners and Managers Association. Note they range from about 30 cents for a factory to over 3 times this much for a hospital.

Line 8 shows the comparatively small percentage required to offset the cost of an air-recovery system. This was computed by dividing line 6 by line 7. Because line 6 is on the high side, actual percentages required will be less than shown.

The largest single cost in operating a building is maintenance, and of maintenance expense, the most money is paid out for plain housekeeping–dusting, porter services, periodic redecorating. Here is where an air-recovery system can repay its initial costs over and over.

No matter how clean the air, some basic cleaning costs (Fig. 2, from Building Owners and Managers Association) cannot be eliminated, such as sweeping, dusting, porter services. In an office, for example, a liberal cost estimate for these services is about 32 cents a sq ft annually. The remainder (22 cents) spent for other cleaning and redecorating costs – washing windows and walls, cleaning lights, dusting high areas–can be reduced by using an air-recovery system.

ABSENTEEISM

To figure what absenteeism costs in a typical building, the first step is to compute wages and salaries for the building types on an annual sq-ft basis (line 9). Salary costs range from $66 in office buildings to less than $3.50 for hotels and motels (based on material from "Economics of Year-Round Air-Conditioning"). Expensive executive talent accounts for the high cost for offices, while comparatively few people (and those generally low-paid) are needed to service a hotel.

Personnel absenteeism rates (line 10) fall around 3 per cent for all types of buildings. Sources for these figures are: offices, Commerce and Industry Association of New York survey of 172 firms; hospitals, report by Northwestern hospital in Minneapolis; industrial buildings, Bureau of National Affairs survey of 56 companies; hotels, motels and stores assumed to have the same rate as offices; schools – 3.14 per cent for teachers (9.5 per cent for elementary students, 5 per cent for junior and senior high school stu-

(*Continued on page 58*)

We propose a

New humidity standard

G. O. HANDEGORD

C. E. TILL

Accurate measurement of humidity is a problem that has faced investigators for some time, and many instruments and techniques have been developed. Each has its advantages and disadvantages, and each has its own restricted range of application. A number of principles of operation are involved in the various instruments, and they vary widely in accuracy, sensitivity, and ease of application.

It is recognized generally that many of the instruments and techniques proposed measure humidity indirectly and must be calibrated in terms of the desired thermodynamic property. Some of the instruments have come to be regarded as "standards," on the assumption that they measure a particular moist air property directly. Such instruments are accepted frequently as standards without proper regard for the definitions of the thermodynamic properties involved or discrepancies between various published definitions. This lack of appreciation of fundamental requirements becomes increasingly apparent as more precise calibration work is attempted.

Measurement of the thermodynamic properties of moist air—The Final Report of the Working Subcommittee, International Joint Committee on Psychrometric Data, sets forth a standard formulation of the thermodynamic properties of moist air, which can claim general acceptance as a standard on the ground that it is thermodynamically consistent within the accuracy of existing knowledge.[1]

Definitions of the terms that are frequently used in describing the condition of moist air, and that are in harmony with the standard formulation, are listed in the ASHRAE GUIDE.[2]

A knowledge of the thermodynamic properties of any atmosphere must first include the temperature and the total pressure. Accurate standards and precise measuring instruments have been developed that make the accurate measurement of these quantities a relatively simple task. Under the standard formulation,[1] all that is necessary to complete the knowledge of the thermodynamic properties of any atmosphere is an accurate numerical value of either of two fundamental thermodynamic properties of the vapor component, the vapor pressure, or the humidity ratio, or an accurate numerical value of either of two derived thermodynamic properties, the wet bulb temperature, or the dewpoint temperature.

Any one of many instruments could be used to provide the required values, but each would require calibration unless it actually indicates the measured quantity by definition. Any instrument that requires no calibration must actually be used to define the quantity it is to measure or, in other words, the measured quantity must be defined in terms of the principle of operation of the instrument. In illustration, the absolute temperature scale can be shown to be identical to a temperature scale defined in terms of the constant-volume ideal gas thermometer.[3] This thermometer, therefore, requires no calibration, as it provides the numerical value of the temperature by definition. All other thermometers require calibration, however, and must be compared to the constant-volume gas thermometer. A similar principle applies to the measurement of the necessary thermodynamic properties of the vapor component of the atmosphere.

A number of practical instruments and techniques have been developed that attempt to measure directly some thermodynamic property of the vapor component of the atmosphere. The acceptance of the definitions of the thermodynamic properties contained in the Report,[1] however, precludes the acceptance of the values given by most, if not all, of these instruments, unless they have been suitably calibrated.

In the measurement of most physical quantities, however, the quantity to be measured is compared with some other quantity of the same kind, which is used as a basis for comparison. The measurement of length is a simple example. This principle may also be applied to the measurement of the thermodynamic properties of moist air by reference to a standard atmosphere of known thermo-

C. E. Till was formerly Research Officer, and G. O. Handegord is with the Prairie Regional Station, Div of Building Research. This paper is a contribution from the Div of Building Research, National Research Council of Canada, and is published with the approval of the division. This is a condensed version of "Proposed Humidity Standard" as presented at the ASHRAE Semiannual Meeting in Dallas, Texas, February 1-4, 1960. The full paper will appear in TRANSACTIONS.

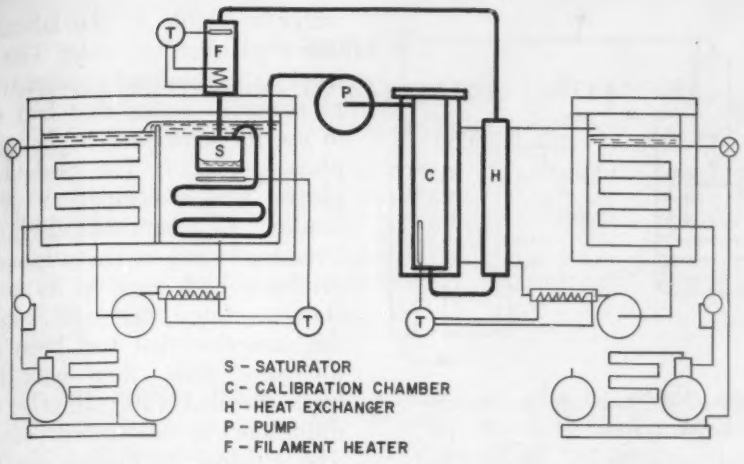


Fig. 1 Schematic diagram of atmosphere producer

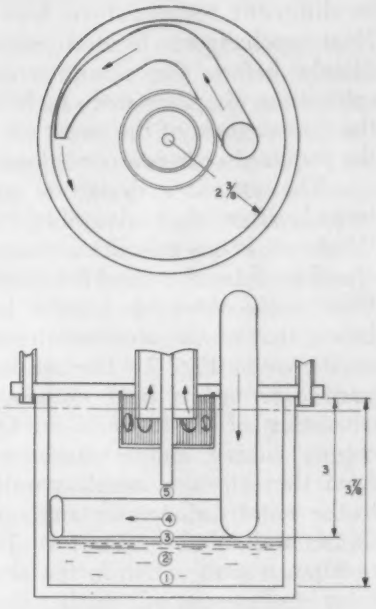


Fig. 2 Saturator for proposed humidity standard

dynamic properties. The accuracy of the method, however, will be directly dependent on the accuracy to which the thermodynamic properties of the standard atmosphere are known.

Production of standard atmospheres – Any standard atmosphere must be defined in terms of an atmosphere in a saturated condition. All definitions and tabulated values of the thermodynamic properties of the vapor component of air-vapor mixtures are directly related to saturation, for it is the only fixed point of reference upon which calculations may be based. For saturation, the condition of moist air must be such that it can coexist in neutral equilibrium with the associated condensed phase presenting a flat surface to it.

Some rather stringent requirements are thus imposed on any saturating device that is to be used to produce standard atmospheres. The water itself must be as pure as is practicable, and it must be shown that any possible impurities will not appreciably affect the vapor pressure over the surface. The surface of the water must be clean and must present a plane surface to the atmosphere. This does not imply planeness in the usual sense, for a radius of curvature of the order of 10^{-4} cm will only introduce an error of 0.1 per cent.

The most important requirement, however, is that of equilibrium, for only under equilibrium conditions can the saturation properties of moist air be defined.

The production of saturated atmospheres alone is not sufficient for practical purposes since most calibration work must be carried out at unsaturated conditions. The saturator must be used to establish the initial condition and a second component is required in which the moist air may be brought to an unsaturated condition through a known and calculable thermodynamic process.

There are a number of types of apparatus described in the literature as suitable for the calibration of humidity sensing devices.[4, 5, 6, 7, 8, 9, 10, 11, 12, 13] Most of these provide an acceptable means for bringing the moist air to the unsaturated condition from initial saturation, but the degree to which initial saturation is achieved may not always be calculable.

Most of the systems proposed utilize a continuous flow process, air from one source being passed through a series of saturating devices, then brought to the desired unsaturated condition, and exhausted to the atmosphere or some other sink. These systems operate on a dynamic, non-equilibrium basis, with water or ice being continuously added or removed from the moist air in the saturator section. In this non-equilibrium situation it is difficult to evaluate exactly the condition of the air effluent from the final saturator. The definition of a saturated atmosphere is not satisfied, owing to the non-equilibrium nature of the process.

The requirements of the definition of a saturated atmosphere can best be met in a practical apparatus by using the recirculation principle. Such an apparatus involves a closed system in which moist air is continuously recirculated over the surface of water or ice in a saturator. The moist air will thus eventually come to neutral equilibrium with the water or ice surface as required by the definition of saturation. The devices utilizing this principle which are described in the literature[12, 13] employ a heating process to bring the air to the desired unsaturated condition. It could also be attained through a change in total pressure between saturator and calibration chamber. Regardless of the technique employed to bring the air stream to the unsaturated condition, the recirculation principle offers the one sound basis for attaining saturation. In a practical atmosphere producer using this principle, complete saturation may not be achieved, but the degree to which it is achieved can be determined and the accuracy of the apparatus definitely established.

Description of the apparatus—The apparatus proposed as a standard in this paper is based on the two-temperature principle, since this lends itself more suitably to recirculation of moist air. A schematic diagram of the apparatus is shown in Fig. 1. It consists essentially of two controlled-temperature liquid sources which maintain the saturator section and calibration section

at different temperature levels. Heat exchangers located immediately before the saturator and calibration chamber serve to bring the temperature of the moist air to the required entrance conditions.

The saturator design is patterned after that described by Wexler.[13] It is a cylindrical copper chamber, 5 in. diam and 5 in. high, filled with water to a level just below that of the air inlet nozzle, as shown in Fig. 2. The air first passes through a heat exchanger consisting of 40 ft of ¾-in. OD copper tubing and is discharged from the saturator nozzle parallel to the water surface and tangential to the wall of the saturator. The resultant vortex action in the saturator induces good mixing and serves as a centrifugal separator before the air leaves through a centrally located discharge port at top of the chamber. A slotted screen surrounding the exhaust port is a further guard against the possibility of droplet carry-over.

The air from the saturator passes over a bare nickel-chrome alloy wire heater where its temperature is raised to approximately the desired level, this heater being operated by a proportional resistance bridge controller. The air then passes through an extended surface heat exchanger to a jacketed calibration chamber. Ethylene glycol-water brine from a second controlled-temperature liquid source is circulated through this heat exchanger and through the jacket surrounding the calibration chamber in order to bring the air temperature to the desired level.

The calibration chamber consists of a jacketed copper cylinder, 4 in. ID and 28 in. long. Access to this chamber is provided by a removable transparent plastics head which is bolted to the top of the chamber through a gasket seal. A sword arrangement secured to the head and extending into the chamber serves as a support for the humidity elements under test.

The air circulation pump consists of two diaphragm-type paint spray compressors operated in tandem. The pumps are arranged to operate 180 degrees out of phase to reduce pressure fluctuation.

Connections between the various components of the air circulation system are made with flexible polyethylene pipe and hose clamps.

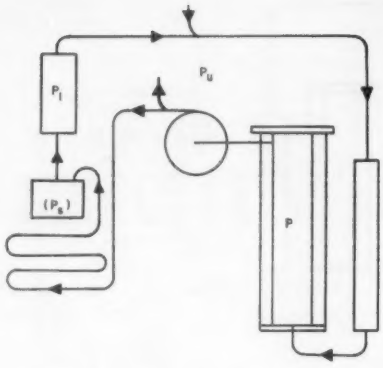


Fig. 3 Leakage in recirculation system

The temperature of the saturator bath is measured using a calibrated platinum resistance thermometer and precision Mueller bridge. A calibrated copper resistance thermometer is used to measure the air temperature in the calibration chamber. Pressure measurements in the calibration chamber and saturator are indicated by simple "U" tube oil manometers.

Performance of the apparatus – Calculation of the humidity of the test atmosphere in the calibration chamber is based on the assumption that the moist air in the system is in neutral equilibrium with the water surface in the saturator at the temperature indicated by the platinum resistance thermometer. It is further assumed that the temperature indicated by the copper resistance thermometer represents the temperature of the air-vapor mixture at any point in the calibration chamber. Measurements were therefore undertaken to determine the extent to which these assumptions were realized, and to evaluate the over-all accuracy of the apparatus.

The extent to which the requirements of the definition of saturation are achieved is dependent on the purity of the water, the planeness of the water surface, the equality of the temperature of the moist air and water surface, and the equilibrium condition between the vapor component of the moist air mass and the water surface.

(a) **Purity of the water**—The purest water available at the laboratory was triple-distilled water. This was used as a standard against which to compare water that had been in use for some time in the atmosphere producer. The method employed was a comparison of the readings of a sensitive electrolytic hygrometer when the atmosphere producer had come to its steady-state condition, first with water in the saturator that had been used for some time, then with fresh triple-distilled water, all other conditions being maintained constant. The electrolytic hygrometer used was sensitive to changes in vapor pressure of less than 0.1 per cent.

In some of the tests the water had been in use for approximately a month; in others the water had been in use for only a few days. In no case was there any detectable difference in vapor pressure of the test atmosphere provided by the fresh distilled water and that provided by water that had been in use for some time.

(b) **Planeness of the water surface** – Observations were made of the condition of the water surface under various air flow rates using a glass-walled saturator. At the desired air flow rates of 3 to 5 cfm, the water surface was only slightly disturbed and no agitation sufficient to cause droplet formation occurred until much higher flow rates were used. Since extremely small droplets would have to be formed to introduce significant errors, the requirement of planeness of the water surface was considered satisfied.

(c) **Equality of the temperature of moist air and water surface** – The transfer of heat to the saturator from its outlet connection, by conduction or by radiation, is minimized in the design of the apparatus.

The saturator heat exchanger was completely immersed in the bath and proved to be of ample capacity to bring the air to the average bath temperature with the flow rates employed. Measurements with calibrated thermocouples and a precision potentiometer indicated that, with 100 F difference between inlet air and saturator temperature, air entering the

TABLE I

SPATIAL VARIATIONS IN SATURATOR TEMPERATURE

	A	B	C	D
Saturator Bath Temperature F	—2.22 ± 0.06	36.50 ± 0.05	43.48 ± 0.04	64.88 ± 0.04
Thermocouple #1	—2.22 ± 0.02	36.50 ± 0.01	43.48 ± 0.02	64.88 ± 0.01
Thermocouple #2	—2.18 ± 0.03	36.50 ± 0.00	43.50 ± 0.02	64.88 ± 0.01
Thermocouple #3	—2.21 ± 0.01	36.50 ± 0.01	43.48 ± 0.01	64.88 ± 0.01
Thermocouple #4	—2.16 ± 0.02	36.50 ± 0.03	43.48 ± 0.01	64.88 ± 0.01
Thermocouple #5	—2.17 ± 0.02	36.50 ± 0.01	43.50 ± 0.02	64.86 ± 0.01

saturator was within ±0.01 F of the average bath temperature.

A series of measurements was made of the temperature of the water and of the air-vapor mass above the surface of the water in the saturator. Thirty-gage thermocouples, calibrated against a platinum resistance thermometer to ±0.01 F, were used in conjunction with a precision potentiometer sensitive to temperature fluctuations of less than 0.01 F. Five thermocouples were used: two measured water temperature and three the temperature of the air-vapor mass at points above the water surface as indicated in Fig. 2.

The saturator bath temperature was measured with the platinum resistance thermometer and Mueller bridge. In each case the calibration chamber temperature was 70.0 F, the flow rate was 3.6 cfm, and the depth of the water in the saturator was ¾ in. The procedure in each case was to calibrate the thermocouples against the platinum resistance thermometer and then to place the thermocouples in the saturator. After a period sufficient for the attainment of the steady-state condition the temperature readings were taken. The thermocouples were then recalibrated.

Table I provides four typical conditions through the full range of relative humidities. The deviations shown are maximum deviations. Case A represents an extreme condition, corresponding to a relative humidity of about 4 per cent, which approaches the most rigorous condition the saturator heat exchanger encounters in practice. Even at this extreme, the average bath temperature, the water temperature, and the temperature of the air-vapor mass agreed to within 0.05 F. In the other three cases the largest observed deviation was 0.02 F. Thus the temperature of the air-vapor mass over the water surface is substantially equal to the average temperature of the saturator bath.

It was difficult to make an accurate direct measurement of the water surface temperature. Thermojunction 2 was just under the water surface and thermojunction 3 was just above it. In no case was there any evidence of a temperature effect owing to evaporation or condensation, and the temperature of the air-vapor mass was substantially equal to the bulk temperature of the water. As there is no possibility of a net radiation exchange with the surface, the surface temperature must be equal to that of the air-vapor mass.

(d) **Equilibrium condition between the vapor component of the air-vapor mixture and the water surface** – The moist air in the system is recirculated repeatedly over the water surface. The steady-state condition of the vapor component must be that of neutral equilibrium with the water surface if there are no sources or sinks present in the recirculation system other than the saturator. Any source or sink that tends to change the relative proportions of air and vapor in the air-vapor mixture tends to upset the neutral equilibrium condition in the saturator. There are two possibilities: (1) a net exchange of moisture between the air-vapor mixture and any moisture sources or sinks, other than the saturator, within the recirculation system; (2) a mass exchange between the air-vapor mixture in the recirculation system and the ambient atmosphere, caused by leakage.

(1) **Moisture exchange**—Aside from the presence of an open liquid or solid water surface, the only appreciable moisture source would be the presence of hygroscopic materials. The recirculation system is made up almost entirely of metals, clear plastics, and polyethylene. The amount of moisture sorbed on these surfaces would be entirely negligible in comparison with the magnitude of the air-vapor mass. Under steady-state conditions there is no source of liquid or solid water within the recirculation system other than the saturator itself. The possibility of a serious moisture sink exists only if the saturator is operated at temperatures above the temperature of the room. Condensation on certain of the recirculation system boundary surfaces might occur. This effect limits the operation of the atmosphere producer to the production of atmospheres in which the dew-point is below the ambient temperature.

(2) **Leakage** – The magnitude of the effect of leakage is dependent upon the amount of moist air that is exchanged with the ambient atmosphere relative to the amount that is recirculated. The case shown in Fig. 3 represents the most severe condition whereby room air enters the system between saturator and calibration chamber and leaves at the pump discharge. The moist air entering the saturator is not in true equilibrium with the water surface, and leaves the saturator at a condition dependent on the efficiency of the saturator. Its vapor pressure is further modified before entering the calibration chamber by mixing with the room air. An expression that may be used to evaluate the error resulting from this condition may be derived as follows:

If p = vapor pressure in calibration chamber,
p_1 = vapor pressure after the saturator, and
p_s = vapor pressure corresponding to saturation at the temperature of the saturator,

then

$$p_1 = p + e\,(p_s - p) \qquad (1)$$

where

e = "saturation efficiency"

If p_a = water vapor pressure in the ambient atmosphere

and g = mass of air exchanged with the room / mass of air circulated in the system

then, to a sufficiently close approximation,

$$p = \frac{p_1 + g p_a}{g + 1} \qquad (2)$$

Substituting Equation (1) in Equation (2) and reducing,

$$p = \frac{ep_s + gp_s}{g + e} \quad (3)$$

The leakage of the apparatus was estimated by pressurizing the system to a gage pressure of 0.6 in. Hg, which was the maximum pressure observed at any point under operating conditions. The decay in pressure, as determined by an oil manometer, was then found to be 0.074 in. Hg in 2.0 min. Assuming the volume of the manometer fluid to be insignificant compared with the volume of the apparatus and assuming a barometric pressure of 28 in. Hg, the leakage may be calculated as 1.31×10^{-3} air changes per min. This value could represent twice the leakage experienced under operating conditions and may safely be assumed as a maximum for purposes of this discussion.

The leakage ratio, g, for the design flow rate of 3.6 cfm and for a system volume of 0.5 cu ft, may be calculated as 1.82×10^{-4}.

The saturation efficiency was determined by opening the system at point "A" in Fig. 3 and circulating room air through the apparatus at the design flow rate. Calibrated electric hygrometer elements were used to determine the inlet and outlet vapor pressures under the five conditions indicated in Table II, and the corresponding "saturation efficiencies" calculated using Equation (1).

It will be noted that when the saturator temperature corresponds to a saturation vapor pressure lower than the vapor pressure of the room air, the "saturation efficiency" is unity. This is no doubt caused by the increase in dehumidifying surface afforded by the heat exchanger. While it is not inconceivable that the accumulation of water or frost on this surface will affect the performance over long periods, it is extremely unlikely that such effects will be significant under a normal calibration program.

The error introduced by leakage is of concern when the room air vapor pressure is lower than that in the saturator, being a maximum when p_a is zero. The ambient atmosphere is maintained at a vapor pressure of approximately 0.2 in. Hg and this value has been employed in determining the error in vapor pressure and dew-point for the range of operation of the apparatus shown in Table III. A tolerance of ± 0.02 F in saturator temperature was also assumed in the preparation of this table, the sign chosen being the one to result in a maximum error.

(e) **Calibration chamber temperatures**—Investigation of the calibration chamber condition was made with 30-gage thermocouples calibrated and used in a manner similar to that used in making the saturator temperature measurements. The temperatures of the air-vapor mass were taken at four positions in the calibration chamber. At each position two thermocouples were used, one shielded from radiation, the other unshielded. Two thermocouples, secured directly to the interior walls, were used to indicate the temperatures of the calibration chamber boundaries. The final thermocouple was inserted in the air stream at the inlet to the heat exchanger.

The spatial variation in the temperature of the air-vapor mass in the calibration chamber and the variation in the temperature of the walls of the calibration chamber for a 12-hour period of test are shown in Table IV. The copper resistance thermometer measuring the calibration chamber temperature read 69.52 $\pm$ 0.03 F during this period. The average temperature of the air stream at the heat exchanger inlet varied from 68.7 to 70.3 F as the load on the system was varied by changing the saturator bath temperature. The cyclical variation was ± 0.4 F. The tolerances quoted in Table IV are maximum deviations.

The results show that the spatial variations in the average temperature of the air-vapor mass were no worse than ± 0.02 F and the total fluctuation in temperature over the 12-hour period was ± 0.05 F at the maximum. The copper resistance thermometer measured the average temperature to an accuracy within its rated sensitivity of 0.03 F.

(f) **Over-all accuracy of the apparatus**—The primary function of the atmosphere producer is in the calibration of electric hygrometer sensing elements in terms of relative humidity. The maximum uncertainty in the values obtained are shown in Table V, based on the possible errors in vapor pressure taken from Table III and assuming an error of ± 0.05 F in the calibration chamber temperature.

The errors listed in Table V represent maximum values determined using the worst possible combination of errors. The probable error will be less for each case. These inaccuracies are a result of the effect of leakage and the present practical limits of temperature control and measurement, and are not caused by any fundamental

TABLE II

DETERMINATION OF "SATURATION EFFICIENCY"

P_e in. Hg	P_a in. Hg	P_r in. Hg	e
0.638	0.208	0.298	0.208
0.436	0.212	0.276	0.287
0.256	0.159	0.185	0.275
0.058	0.131	0.056	1.03
0.064	0.270	0.065	0.995

TABLE III

CALCULATED DEVIATION IN VAPOR PRESSURE AND DEW-POINT

Saturator Temperature F	Vapor Pressure in. Hg	Maximum Deviation in Vapor Pressure %	Maximum Deviation in Dew-point F
70	0.73916	—0.12	—0.04
60	0.52160	—0.11	—0.03
50	0.36240	—0.10	—0.03
40	0.24767	—0.09	—0.02
30	0.1645	+0.09	+0.02
20	0.1027	+0.11	+0.03
10	0.06286	+0.14	+0.03
0	0.03764	+0.19	+0.03
—10	0.02203	+0.26	+0.04
—20	0.01259	+0.39	+0.07

TABLE IV

CALIBRATION CHAMBER TEMPERATURES

Thermocouple Position	Details	Temperature F
A	Shielded from radiation	69.54 ± 0.03
A	Unshielded	69.54 ± 0.03
B	Shielded from radiation	69.52 ± 0.03
B	Unshielded	69.51 ± 0.02
C	Shielded from radiation	69.52 ± 0.05
C	Unshielded	69.53 ± 0.02
D	Shielded from radiation	69.51 ± 0.04
D	Unshielded	69.52 ± 0.02
E	Wall temperature	69.5 ±0.1
F	Wall temperature	69.5 ±0.1

TABLE V

MAXIMUM UNCERTAINTY IN THE RELATIVE HUMIDITY EXPRESSED IN PER CENT R.H.

Temperature F	Relative Humidity				
	10% R.H.	25% R.H.	50% R.H.	75% R.H.	100% R.H.
90	0.03	0.06	0.14	—	—
70	0.03	0.06	0.14	0.20	0.29
50	0.04	0.08	0.14	0.21	0.29
30	0.06	0.11	0.18	0.25	0.33
10	—	0.17	0.24	0.34	0.40

characteristic of the method. It is anticipated that improvements to the present model will be made with a view to the elimination of leakage and to more precise measurement and control of temperature.

CONCLUSIONS

1. The definitions of the thermodynamic properties of moist air given in the Final Report of the International Joint Committee on Psychrometric Data leave little scope for the establishment of a fundamental standard of humidity other than by the production of a standard atmosphere.

2. An atmosphere producer, employing recirculation of moist air in a closed system, provides a practical fundamental standard for humidity which is consistent, in principle, with the definitions given by the Report of the International Joint Committee on Psychrometric Data.

3. The condition of the air-vapor mass in the recirculation system of the atmosphere producer described in this paper necessarily satisfies the definition of an atmosphere saturated at the measured temperature T_1 and the measured total pressure P_a, within a small tolerance. This tolerance arises from the practical limitations in temperature control and the practical limitations on the establishment of the neutral equilibrium condition.

4. In contrast to those systems that do not involve recirculation, the limitations on the knowledge of the condition of the air-vapor mixture in this atmosphere producer may be precisely evaluated. The maximum uncertainty in the vapor pressure of the test atmosphere is in the order of 0.1 per cent in the temperature range from 0 to 70 F. The maximum uncertainty in the dew-point is in the order of 0.03 F in the same temperature range. The maximum uncertainty in relative humidity is, on the average, 0.2 per cent R.H. through the full range of the relative humidities at temperatures from 10 to 70 F.

5. The range of humidities that the atmosphere producer is capable of producing is limited in the present arrangement to dew-points between −20 and 70 F. The lower limit is fixed by the capacity of the saturator bath refrigeration unit, and the upper limit is fixed by the ambient temperature. The lower limit of the dry-bulb temperature is 10 F, set by the capacity of the air-temperature bath refrigeration unit. The upper limit is presumably fixed only by the boiling point of the glycol-water mixture.

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Coil rating factor

puts heat exchanger on a comparable basis

DONALD G. RICH
Member ASHRAE

Determining the optimum core geometry for heat exchangers is complicated by the fact that the rate of heat transfer and friction energy per unit surface area may vary over wide ranges for commonly used surface configurations. Furthermore, what may be optimum in surface area may not be optimum in weight, volume, or cost.

The object of this study is to describe a simple method of comparing heat exchangers and illustrate its application to the comparison of surface area, weight, volume, and face area requirements for three practical heat exchanger geometries.

COIL RATING FACTOR DEFINED

Although any fluid may be considered, let it be assumed that the primary fluid, i.e. the fluid whose heat transfer and friction performance is of primary interest, is air. The secondary fluid will be referred to as the tube side fluid, although it is not necessary that this method be restricted to tubular heat exchangers. Also, it will be assumed that only sensible heat transfer occurs on the air side. The coil rating factor, Z, is defined as the pressure drop times the mean temperature difference between the air and the tube side fluid divided by the temperature rise or fall of the air.

$$Z = \frac{\Delta p\, \theta_m}{\theta_a} \qquad (1)$$

Equation may also be written terms of the thermal resistance in the form:

$$Z_{70} = \frac{\Delta p_{70}}{L}\left(R_{a70} + R_m + \frac{R_s}{h_t}\right) G \frac{c_{p70}}{\quad} \qquad (2)$$

Donald G. Rich is a Senior Research Engineer, Carrier Corporation. This paper, here somewhat condensed, was presented as, "A Method of Comparing Heat Exchangers," at the ASHRAE Semiannual Meeting in Dallas, Texas, February 1-4, 1960.

where s_v is the compactness parameter — ft² surface area per ft³ core volume, G is the mass face velocity, L is the coil depth in the air flow direction, and R_s is the ratio of the effective air side surface area to the effective tube side surface area. A standard temperature and pressure of 70 F and 1 atmosphere has been arbitrarily selected as a basis of comparison.

An inspection of Equation (2) reveals that each term is relatively independent of the overall dimensions of the heat exchanger, being a function only of the geometry and the mass velocity.

BASIS OF COMPARISON

Fig. 1 illustrates heat transfer and pressure drop data for three smooth spiral fin heat exchanger geometries obtained in the Carrier Corporation heat transfer laboratory. A tabulation of the physical characteristics of these heat exchangers appears in Table I.

The abscissa in Fig. 1 is the mass velocity, expressed as a linear velocity of standard air. The ordinates, air thermal resistance and pressure drop per in. of coil depth, have been corrected to a standard air temperature of 70 F.

Since the coil rating factor and the air side thermal resistance are both functions only of the mass velocity it is possible to plot the thermal resistance versus the rating factor as shown in Fig. 2.

The coil rating factor, Z'_{70}, was computed from Equation (2) with the metal and tube side thermal resistances neglected.

Likewise, by assuming a value for the tube side heat transfer coefficient, it is possible to compute the overall thermal resistance and plot this against a coil rating factor based on this overall thermal resistance, as shown in Fig. 3.

Fig. 3 represents a comparison based on overall performance whereas Fig. 2 represents a comparison based on air side performance only.

In order to understand clearly the significance of the coil rating factor as a basis for comparing heat exchangers, assume that two heat exchangers are sized so that they cool or heat the same air weight flow (cfm of std. air) the same num-

"In order to compare and evaluate heat exchangers having different heat transfer and friction performance characteristics, it is desirable to assume that each operates at the same flow rate, mean temperature difference, total heat transfer rate and pressure drop, in which case the velocity, face area and depth are variables. . . .

All of these comparisons have a common parameter, the coil rating factor, so that all may be made on a single chart having a single abscissa and multiple ordinates. . . . Such a chart provides a valuable basis for the comparison and eventual optimization of heat exchanger geometries."

TABLE I

Coil	—	A	B	C
Fins per in.	in.$^{-1}$	13.9	9.39	13.7
Fin height	in.	13/32	13/32	5/16
Fin base thickness	in.	0.008	0.008	0.008
Fin material	—	Copper	Copper	Copper
Tube outside diameter	in.	5/8	5/8	5/8
Tube wall thickness	in.	0.025	0.025	0.025
Tube material	—	Copper	Copper	Copper
Surface ratio	—	21.0	14.4	14.9
Tube face spacing	in.	1-25/64	1-25/64	1-7/32
Tube row spacing	in.	1-13/64	1-13/64	1-1/16
Arrangement	—	Staggered	Staggered	Staggered
Compactness	ft^2/ft^3	275	188	252
Weight factor	ft^2/lb	5.05	4.06	3.90
Metal resistance	hr/ft^2/F/Btu	0.0075	0.0074	0.0040

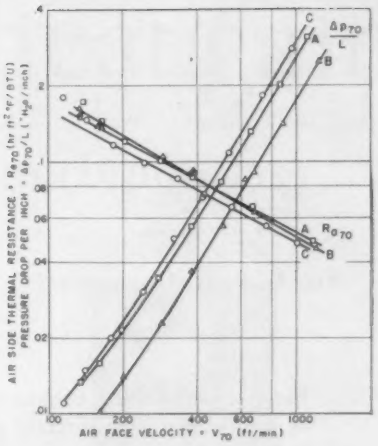


Fig. 1 Heat transfer and pressure-drop for three spiral fin heat exchanger geometries

ber of deg at the same pressure drop. Furthermore, assume that their entering air temperature, tube side fluid temperature, and tube side fluid temperature drop are identical. Then the overall mean temperature difference, θ_m, will be the same and, from Equation (1), the Z factor will be the same. Consequently, by comparing heat exchangers at the same value of the coil rating factor, one may consider that the performance aspects are identical, with the physical characteristics: size, shape, surface area, weight, and volume – left as dependent variables. Fig. 4 shows block diagrams of two heat exchangers compared on this basis. Coil I would, in general, be a geometry having a higher pressure drop than Coil II at the same velocity and, consequently, must have a larger face area in order to operate at a lower velocity and the same pressure drop.

SURFACE AREA COMPARISON

Turning back to Fig. 3, at a Z factor of 0.2 in. H_2O coils A, B, and C have overall thermal resistances of 0.134, 0.123 and 0.115 hr/ft^2/F/Btu respectively. The overall resistance, however, can be written as

$$R_o = \frac{S\Theta_m}{q} \qquad (3)$$

and, since the coils are being compared at the same total heat transfer, q, and mean temperature difference, θ_m, the surface area requirements will be in direct proportion to the overall thermal resistances. Consequently, it can be stated that Coil A requires about 9% more surface area than Coil B and 16.5% more surface area than Coil C under identical performance conditions. Fig. 2 may be interpreted in the same manner for the case where the tube side and metal resistances are negligible.

It is important to note the influence of both tube side heat transfer coefficient and operational velocity on the relative ranking of the heat exchanger geometries. Whereas at Z = 0.2 in. H_2O Coil A required 9% more surface area than Coil B when operating with a tube side coefficient of 400 Btu/hr/ft^2/F, Fig. 3, Coils A and B require about the same surface area in an application where the tube side and metal resistances are negligible, Fig. 2. Note also from Fig. 2 the effect of Z on the relative ranking of heat exchangers A and B. At low velocity (small Z value) Coil A is superior (from a surface area consideration) whereas at high velocities Coil B is better. Coil C, on the other hand, requires less surface area than the others over the entire velocity range for all tube side coefficients.

VOLUME AND WEIGHT COMPARISONS

Fig. 5 illustrates a volume comparison between the three heat exchangers which is obtained by plotting the thermal resistance divided by the compactness versus the coil rating factor. This gives an ordinate which is equal to the volume divided by the total heat transfer rate per unit mean temperature difference.

Since comparisons are being made at equal values of q and Θ_m, then the ratio of the ordinates, at fixed Z, is equal to the ratio of the core volumes at equal performance conditions. A weight comparison

Fig. 2 Air side surface area comparison – Air thermal resistance dominating

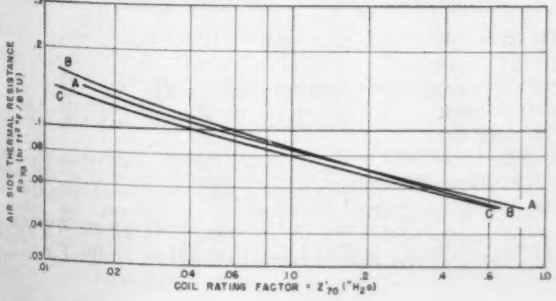
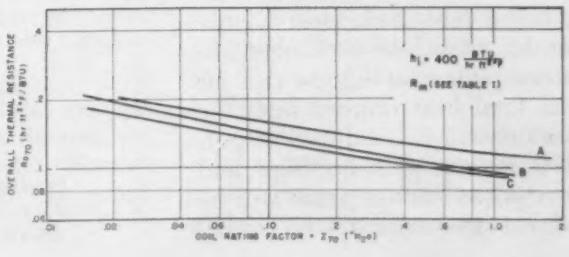


Fig. 3 Air side surface area comparison –Values of the ordinate are directly proportional to air side surface area



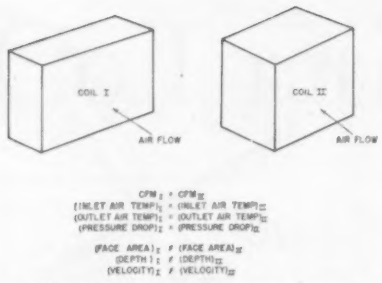

COIL I
AIR FLOW
COIL II
AIR FLOW
CFM I = CFM II
(INLET AIR TEMP) I = (INLET AIR TEMP) II
(OUTLET AIR TEMP) I = (OUTLET AIR TEMP) II
(PRESSURE DROP) I = (PRESSURE DROP) II
(FACE AREA) I ≠ (FACE AREA) II
(DEPTH) I ≠ (DEPTH) II
(VELOCITY) I ≠ (VELOCITY) II

Fig. 4 Basis of comparison

Fig. 5 Core volume comparison—Values of the ordinate are directly proportional to the core volume

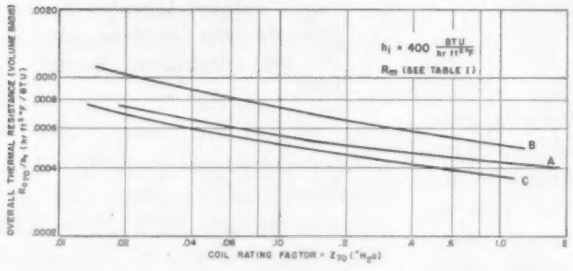
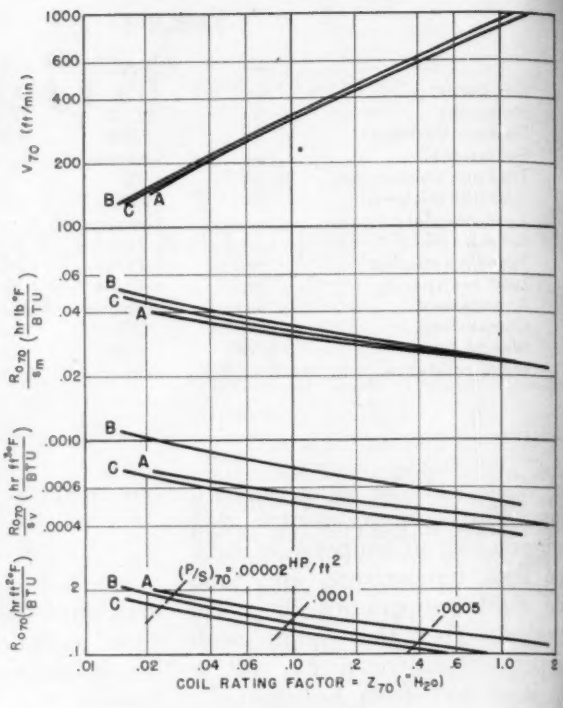

OVERALL THERMAL RESISTANCE (VOLUME BASIS)
R_{o70}/h_i (hr ft³ °F / BTU)
h_i = 400 BTU / hr ft² °F
R_m (SEE TABLE I)
A
B
C
COIL RATING FACTOR = Z_{70} ("H₂O)

Fig. 6 Consolidated comparison chart



may be made in the same manner by dividing the thermal resistance by the weight parameter, s_m, ft² of surface area per lb core weight.

Any number of parameters, or even weighted groups of parameters, may be optimized in this way provided they are directly proportional to the heat exchanger surface area.

CONSOLIDATED COMPARISON

One of the advantages of the coil rating factor parameter is that it remains the same regardless of what is being optimized. Consequently, several comparisons may be made on the same graph, Fig. 6. Also shown at the top of Fig. 6 are curves which allow determination of the face velocities corresponding to each coil rating factor. Since the heat exchangers are assumed to be operating at the same cfm, then the ratio of the velocities will be inversely as the ratio of the face areas at the same Z factor. Another way in which the velocity lines may be used is in the case where the velocity, hence face area, must be the same for each heat exchanger. In this case, it is easy to show that for equal total heat transfer rates the Z factors will be in direct proportion to the coil pressure drops, and the required surface areas will be in direct proportion to the overall thermal resistances corresponding to these Z factors.

CONCLUSIONS

The coil rating factor, as a basis for comparing heat exchangers, offers several advantages to the designer of heat transfer equipment.

1. It allows comparisons to be made under identical heat transfer and friction performance conditions.
2. The effects of tube side heat transfer coefficient and metal thermal resistance, which can be important to the selection of an optimum geometry, are easily included.
3. It can be used to optimize surface area or any other parameter which is directly proportional to surface area. Furthermore, the results obtained can be interpreted quantitatively.
4. The coil rating factor is not dependent upon the parameter being optimized. This is an advantage because it permits graphical comparisons of

(*Continued on page 58*)

NOMENCLATURE

c_p	specific heat at constant pressure	(Btu) (lb_m^{-1}) (F^{-1})
G	mass velocity	(lb_m) (hr^{-1}) (ft^{-2})
h_i	tube side heat transfer coefficient	(Btu) (hr^{-1}) (ft^{-2}) (F^{-1})
L	length in flow direction	(in.)
Δp	static pressure drop	(in. H_2O at 60 F)
P	friction power	(hp)
q	heat transfer rate	(Btu) (hr^{-1})
R_a	air thermal resistance	(hr) (ft^2) (F) (Btu^{-1})
R_m	metal thermal resistance	(hr) (ft^2) (F) (Btu^{-1})
R_o	overall thermal resistance	(hr) (ft^2) (F) (Btu^{-1})
R_s	surface ratio = S/S_i	
s_m	air side surface area per unit core material mass	(ft^2) (lb_m^{-1})
s_v	air side surface area per unit core volume	(ft^2) (ft^{-3})
S	total air side surface area	(ft^2)
S_i	total tube side surface area	(ft^2)
θ_a	air temperature difference	(F)
θ_m	overall mean temperature difference	(F)
Z	coil rating factor based on overall thermal resistance	(in. H_2O at 60 F)
Z′	coil rating factor based on air side thermal resistance	(in. H_2O at 60 F)

How drapes affect heat gain

as tested with regular and heat absorbing glass

N. OZISIK

L. F. SCHUTRUM
Member ASHRAE

Effectiveness of drapes in reducing solar heat gain through sunlit glass windows was investigated experimentally by testing drapes of different materials and colors in combination with a regular plate glass and a heat absorbing glass. The results are presented in terms of the solar heat transfer factor, K, defined as the ratio of the solar heat gain through a glass and a drape combination to the incident solar radiation on the glass surface. The K factor curves are given for the entire range of solar reflectance and absorptance of the shade materials and for different glasses. Knowing the type of glass and solar properties of the shade material, the solar heat gain can be determined from the curves.

The over-all coefficients of heat transfer based on indoor and outdoor air temperature differences are also given.

The materials commonly used as drapes ranged in transmittance for solar radiation from about 70 per cent to almost opaque, and reflectance and absorptance were variables for a given transmittance. The types of materials tested were selected with the advice of manufacturers of drapery materials, to cover the range of these variables.

A 100 per cent fullness was used for all the drapes tested except one. Separate tests were made to investigate the effect of pleating on the transmittance and reflectance.

N. Ozisik was formerly Research Engineer, L. F. Schutrum is Research Supervisor, ASHRAE Research Laboratory. This paper, here slightly condensed, was presented as "Solar heat gain factors for windows with drapes" at the ASHRAE Semiannual Meeting in Dallas, Texas, February 1-4, 1960. The complete paper will appear in TRANSACTIONS.

TYPES OF MATERIALS TESTED

Drapery materials selected for testing included the following types:

1) Cotton, dark green, 6.06 oz per sq yd, yarn counts: 91 warp-36 filling.
2) Cotton, dark green, vinyl coated (same material as used for roller shade studies).
3) Cotton, beige, 6.18 oz per sq yd, yarn counts: 91 warp-36 filling.
4) Fiber glass, dark grey.
5) Fiber glass, tan, 7.55 oz per sq yd, yarn counts: 57 warp-29 filling.
6) Fiber glass, light grey.
7) Fiber glass, off white, 5.72 oz per sq yd, yarn counts: 61 warp-58 filling.
8) Glass cloth, white with golden stripes.
9) Dacron, white, 1.8 oz per sq yd, yarn counts: 86 warp-81 filling.

The solar reflectance and transmittance of the materials tested were measured at the Laboratory using a pyrheliometer. Solar reflectance of the flat material was determined by comparing reflectance with that of a magnesium carbonate block, for which the reflectance was approximately 0.95. The solar transmittance of the flat material is the ratio of the sun's energy passing through the cloth to the energy incident upon the cloth. The solar transmittance and reflectance of the drapery materials thus tested are given in Table I.

Similar tests were made to determine the transmittance and reflectance of the materials when pleated like a drape. The pleated form was produced by fixing the material between two imposed frames 25 in. sq, the intermatching edges of which were cut to simulate the pleats of a drape. The reflectance and transmittance of the pleated material were compared with those of the flat material by alternate readings of the pyrheliometer. In the range of transmittances from 20 to 50 per cent, the direct normal transmittance of a drape with 100 per cent fullness was almost the same as that of the flat material, but at 45-deg. incidence was about 20 per cent less. For diffuse solar radiation, the transmittance of a drape was about 20 per cent less than that of the flat material. The reflectance of the drape was about 15 to 20 per cent less than that of the flat material for normal incidence and 5 to 10 per cent less for 45-deg. incidence.

Test apparatus—The solar calorimeter used in these studies was described in an earlier publication. The 42 in. sq opening of the calorimeter, covered with a ¼-in. thick glass, was used as the test window through which heat gain was measured. The properties of the glasses used are given in Table I.

The drape was hung with a standard light weight rod behind the glass as shown in Fig. 1, and the distance between the rod and glass was either 3 or 5¾ in. Heat passing through the glass and shade was collected by the fluid circulating in the tubes of the calorimeter, and the inlet temperature of the circulating liquid could be controlled as desired.

Intensity of direct and diffuse solar radiation was measured with two Eppley thermoelectric type pyrheliometers. The amount of heat

transfer was obtained from the temperature rise and the flow rate of the circulating liquid. All temperatures were measured by means of copper-constantan thermocouples. A view of the solar calorimeter with a drape in the window is shown in Fig. 2.

Test procedure – Over-all coefficients of heat transfer for a glass and drape combination were determined from the winter tests with an average outdoor air temperature of about 25 F and without solar radiation. Effect of spacing between the glass and drape on the U values was investigated by varying the rod to glass spacing from 3 to 5¾ in.

The summer heat gains were investigated with solar radiation, and tests were made either with the calorimeter following the sun or with a fixed orientation. Drapes from nine different materials were tested in combination with regular plate and/or heat absorbing glass. The inside surface of the solar calorimeter was kept at a nominal temperature of 75 F.

Analysis of solar heat gain – When solar radiation falls upon a glass with a drape, part of this radiation is transmitted through the glass and drape, unless the drape is opaque, part is reflected back, and the remainder is absorbed by the glass and drape. Knowing the transmittances and reflectances of the glass and drape and the intensity of the solar radiation, the energy transmitted can be calculated. If the edges of the drape were sealed to the window frame so that there would be no air circulation between the glass-drape spacing and the room, it would be possible thereby to calculate the amount of heat flow into the room by convection and radiation resulting from the solar energy absorption of the drape.

In practice, however, a drape hangs freely, and air circulates between the glass-drape space and the room, and additional heat is carried into the room by the circulating air.

Therefore, the convection and radiation component of solar heat gain with a sealed drape is less than that for a freely hanging drape, but the additional heat gain due to air circulation could not be calculated.

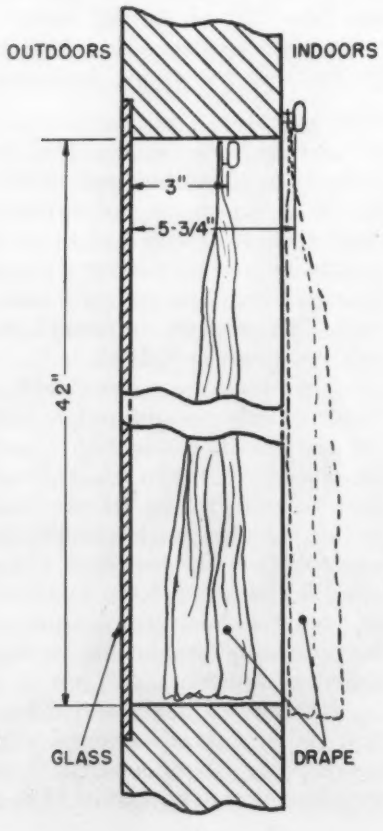
TABLE I

SOLAR PROPERTIES OF DRAPERY MATERIALS AND GLASSES

Material	Transmittance	Absorptance	Reflectance
Cotton, dark green	0.05	0.80	0.15
Cotton dark green, vinylcoated	0	0.85	0.15
Cotton, beige	0.23	0.26	0.51
Fiber glass, dark grey	0.11	0.60	0.29
Fiber glass, tan	0.14	0.44	0.42
Fiber glass, light grey	0.23	0.30	0.47
Fiber glass, off white	0.35	0.05	0.60
Glass cloth, white with golden stripes	0.54	0.05	0.41
Dacron, white	0.70	0.02	0.28
Glasses			
Ordinary window	0.87	0.05	0.08
Regular plate	0.77	0.16	0.07
Heat absorbing	0.41	0.53	0.06

Note: All values are for normal incidence.

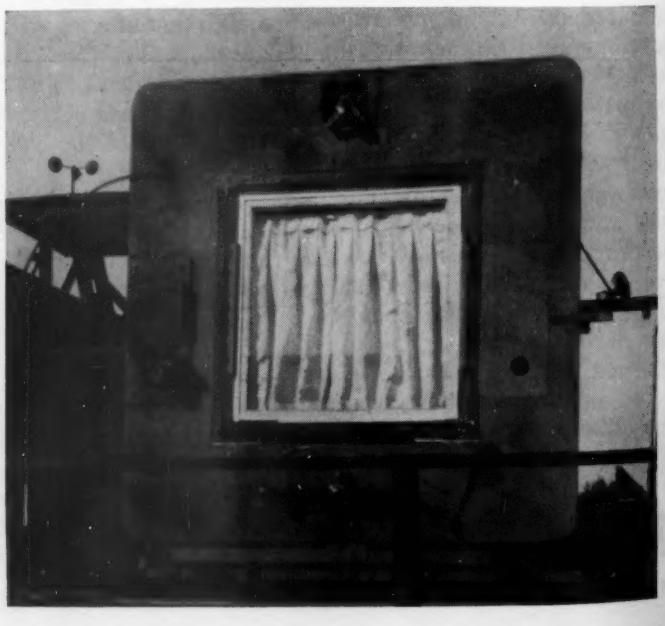
Fig. 1 Position of drapes



RATIO FROM TESTS

Here, the ratio of the convection and radiation component of the solar heat gain with a freely hanging drape to that with a sealed drape was determined from the test data.

Fig. 2 The solar calorimeter



Total solar heat gain is the sum of the transmitted and convection-radiation components of the solar heat gain. In order to simplify the heat gain calculations, a solar heat transfer factor K, defined as the ratio of the solar heat gain through a glass and drape (freely hanging) combination to the incident solar radiation on the outer surface of the glass was developed. This K factor, when multiplied by the incident solar radiation gives the total solar heat gain.

There is also the conduction heat gain due to the indoor-outdoor air temperature differences. This can be obtained by multiplying the over-all coefficient of heat transfer (i.e. U) by the air temperature difference.

Thus, the total heat gain through a glass and drape combination can be expressed by the following equation:

$$Q = K\,I\,A + U\,(t_o - t_i)\,A \qquad (1)$$

Note, however, that K values are different for diffuse and direct solar radiation. Furthermore, if only a portion of the glass surface is irradiated by the direct solar radiation, the Equation 1 can be written as follows:

$$Q = K_D\,I_D\,A\,(1 - P) + K_d\,I_d\,A + U\,(t_o - t_i)\,A \qquad (2)$$

where P is the fraction of the glass surface in shade.

TEST RESULTS

Over-all coefficients of heat transfer, U, for glass and drape combinations were determined from the winter tests with an average outdoor air temperature of about 25 F with no solar radiation. The U value for materials of medium transmittance, after being adjusted for an outdoor conductance of 3 Btu per (hr) (sq ft) (F), was 0.76. Note that this value is the same as that for a glass with a roller shade. For materials with low or high transmittance, the over-all coefficients of heat transfer were about 5 per cent lower or higher than this respectively. These results are for a rod located 3 in. from the glass; with the rod at 5¾ in., U values were about 10 per cent higher.

As indicated above, the total heat gain measured by the calorimeter was the sum of conduction heat transfer due to indoor-outdoor air temperature difference, and the transmitted and convection-radiation components of the solar heat gain. The conduction heat transfer and the transmitted component could be calculated from the known values of the over-all coefficient of heat transfer, indoor and outdoor air temperature difference, and the transmittance of the drape and glass. The convection and radiation component of the solar heat gain could, therefore, be determined by deducting from the total heat gain the conduction and transmitted components.

The experimental value thus obtained was then compared with the convection and radiation component of solar heat gain for a sealed drape.

The ratio of the convection and radiation component of the solar heat gain with an unsealed drape to that of a sealed drape was determined for over 150 tests made with nine different materials. As shown in Table I, the solar absorptances of these materials ranged from 5 to 85 per cent, transmittances from zero to 70 per cent, and the emissivity for long-wave radiation was about 0.9 on both sides of the material.

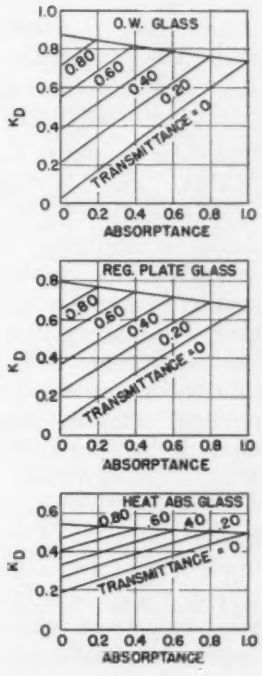


Fig. 3

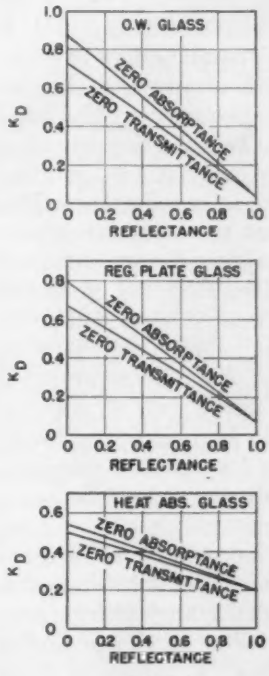


Fig. 4

Fig. 3 and 4 Values of the solar heat-transfer factor K_D for direct solar radiation and incidence angles ranging from 0 to 50 deg

Note 1: For incidence angles in the range 50 to 85 deg, decrease K_D by 10 per cent, for each 10 deg. increase in incidence angle above 50 per cent.
Note 2: K_d values for diffuse solar radiation are 10 per cent less than the values of K_D given in the graphs.

For all the drapes tested, this ratio averaged within ±6 per cent of 1.25 for a regular plate glass and 1.35 for a heat absorbing glass. Knowing this ratio, the solar properties of the glass and drape material, and taking the space conductance h_a, indicated above, the solar heat gain factor K could be calculated for any indoor and outdoor conductances.

Fig. 3 gives the K factors thus calculated for an outdoor conductance of 3 Btu per (hr) (sq ft) (F) and an indoor conductance for a heat absorbing, a regular plate and an ordinary window glass, as a function of solar absorptance and

transmittance of the flat material. Fig. 4 shows the data in Fig. 3 replotted as a function of the solar reflectance of the material. Since the sum of reflectance, transmittance and absorptance is unity, with a given reflectance many combinations of transmittance and absorptance are possible. With a given reflectance, however, a zero transmittance and a zero absorptance are the two limiting conditions. Therefore, K curves in Fig. 4 are for these limiting cases, and K values for all combinations of transmittance and absorptance lie between these two curves. The band between the two limiting curves is considerably reduced by plotting K against the solar reflectance. This indicates that the solar reflectance of the material is the predominant variable influencing the K factor. With a maximum deviation of about 10 per cent, these two limiting curves could even be represented by a mean curve; such an approximation could be useful in estimating K values for practical purposes, knowing only the solar reflectance of the flat material.

The K factors given in Figs. 3 and 4 are for direct solar radiation and for incidence angles* from zero to 50 deg. For incidence angles above 50 deg., K values in these figures should be decreased by 10 per cent for each 10 deg. increase in incidence angles. K factors for diffuse solar radiation are about 10 per cent less than Fig. 3 or 4 values.

The drape temperature was measured with thermocouples at different points. With solar radiation, however, the temperature reading of each thermocouple varied considerably depending on the location of the junction on the pleats. No satisfactory average could be obtained. Furthermore, with translucent materials, the thermocouple readings were influenced by the bonding material which attached the junction to the drape. However, it was concluded that the average temperature of a drape was a little less than that of a roller shade of the same material.

Application of data—The heat flow through a glass with a drape can be calculated with Equation 2, knowing the intensity of incident solar radiation on the glass surface, indoor and outdoor air temperatures, and the K and U values. The K values for incidence angles 0 to 50 deg. can be taken directly from Figs. 3 or 4; for incidence angles above 50 deg., Fig. 3 or 4 values should be adjusted by decreasing K by 10 per cent for each 10 deg. increase in incidence angle above 50 deg. The K value for the diffuse solar radiation can be taken as 10 per cent less than the Figs. 3 and 4 values. The U value for a drape with glass can be taken as 0.76.

* Angle between the sun's beam and the normal to the glass surface.

RESULTS

The solar heat gain factor K given in Figs. 3 and 4 is a direct measure of effectiveness of a glass and a drape combination in excluding solar heat; the smaller the K, the smaller is the solar heat gain. However, considering the fact that a shading device should permit transmission of a reasonable amount of daylight into the room while excluding the solar heat, the smallest K value accompanied with a zero transmission is not necessarily a desirable property. A compromise is needed. The two curves in Fig. 4 give K values as a function of the solar reflectance of material for a zero transmittance (i.e. opaque) and a zero absorptance.

K values for an opaque material are on the zero transmittance curve, and those for translucent materials are between the zero transmittance and zero absorptance curves. Since a translucent material permits daylight to enter a room, such a material with reasonable solar reflectance may be a good compromise between heat exclusion and light transmission requirements of a drape.

The K value of a drape can be determined from Fig. 4, knowing solar reflectance of the material. The reflectance for the visible range of the spectrum, however, is a more commonly used property than the solar reflectance. Therefore, if a relation were known between these reflectances, Fig. 4 would have a more practical application in determining the K value. Furthermore, knowing the relation between the transmittances of the material in the solar and visible range of the spectrum, Fig. 3 or 4 would serve to indicate the amount of light as well as the solar heat entering the specific room.

This phase of the problem is not included in the present investigation; it can be a subject of a separate investigation.

All drapes tested except one had 100 per cent fullness. The K values for these drapes were not appreciably different from those given in an earlier paper for roller shades of the same material. Similarly, an increase in the amount of fullness up to 200 per cent would not significantly influence the K value.

The data in Fig. 4 indicate that the K value is smaller for materials with a high solar reflectance; and such materials usually are the light colored materials, (i.e. white, light beige, cream, etc.). A light colored material with a medium transmittance will let daylight into the room and exclude more solar heat than a dark material. With a white drape of medium to zero (opaque) transmittance, the K value is slightly higher with a heat absorbing glass than with an ordinary window glass. However, with dark materials (i.e. low solar reflectance) the K value is lower with a heat absorbing glass than with an ordinary window glass.

CONCLUSIONS

Solar heat gain through a single glass with a drape can be obtained by multiplying the incident solar radiation on the glass by the K factor.

K factors are given as a function of the solar properties of drape materials for an ordinary window, a regular plate and a heat absorbing glass in Figs. 3 and 4.

The solar reflectance of a material on the glass side largely determines the solar heat gain. A material with a high solar reflectance on the glass side excludes more solar heat than a material with a low reflectance.

Effectiveness of glass and drape combinations in excluding solar heat can be compared directly by their K factors. For the draperies tested with regular plate glass, solar heat gains ranged from about 45 to 75 per cent of those for unshaded glass with white (60 per cent reflectance) to dark green (15 per cent reflectance) drapes.

20,000 Members Can't Be Wrong

DANIEL D. WILE

During the past months, this President's Page has had articles by guest authors covering various segments of the Society. I am taking the opportunity to present an overall review of the Society's operation and its relation to the individual members.

At the time of the merger, ASHAE had 11,500 members, ASRE 7000, but there were 1000 of these who held membership in both Societies so ASHRAE started with approximately 17,500 members. In the past 16 months of merged operation we have gained 2000 members for a present total of 19,600 and this should soon pass the 20,000 mark. We have 88 Chapters of which 3 have been added and one lost since the merger.

We are now fifth in size among the technical societies with the Electrical (AIEE), Mechanical (ASME), Civil (ASCE), and Mining (AIME) Engineers leading in that order and with the Chemicals (ASCLE) following slightly behind us.

Size, of itself, is not a virtue, but we can not ignore that our steady growth represents a tacit approval of our aims and objectives, by the members of our profession. Our size now imposes an increasing responsibility to better serve our members, our industry and the general public.

We must never lose sight of the fact that we are a technical society whose expressed purpose is "to advance the arts and sciences of Heating, Refrigeration, Air Conditioning and Ventilation, and the allied arts and sciences for the benefit of the general public." We are not a social club, nor a business organization, nor a trade association. We are a nonprofit organization of engineers devoted to advancing our particular arts and sciences.

The day to day functioning of our Society is handled by a paid staff working with the officers, the Board of Directors, and the committees. The staff includes 54 employees of which 38 are at headquarters in New York and 16 at the Research Laboratory in Cleveland. The staff operation is managed by the Executive Secretary and is organized under department heads which include the Technical Secretary, Membership Secretary, Assistant to the Treasurer and the Editors.

ASHRAE is in the publishing business and no small part of headquarters operation is the editing and publishing of the JOURNAL, the GUIDE, and TRANSACTIONS, along with a sales department for the sale of advertising space in the JOURNAL and the GUIDE. I am sure that many members will be interested to know that the Publications Committee and the Editor of the JOURNAL have been active in their efforts to improve the attractiveness and readability of the JOURNAL while still maintaining a necessary technical quality.

ASHRAE is unique among the technical societies in maintaining its own Research Laboratory. It is managed by a Director of Research but the operation is guided by the Research and Technical Committee. The Laboratory, in the past, has worked on a wide variety of projects but following a recent study it has been decided to confine its work to research in the field of environment. We must also serve the other interests of our members such as heating and refrigeration. This will be done through arrangements with universities or other institutions which are especially equipped in the particular field.

Finances are also in large figures, with a current budget of slightly over one million dollars for Society operation plus over two hundred thousand dollars for the research operation. About 43% of our income is from membership dues, approximately 46% from publications of which the major part is the sale of advertising and the 11 remaining per cent in contracts and contributions to the research budget including income from the International Heating and Ventilating Exposition.

Our current financial operation is running at an appreciable deficit, but important steps have been taken to reduce expenses and increase income. These include a $50,000 reduction of headquarters pay roll and changes in our advertising sales organization. The proposed budget that will be submitted to the Board of Directors for the fiscal year beginning July 1 shows a definite balance on the favorable side.

The Society is governed by the Board of Directors which now consists of 27 members but will reduce to 24 members as soon as the interim period of the merger is passed. The 24 members will include 10 Regional Directors, 9 Directors at Large, the 4 officers, and the immediate Past President. All officers and directors are elected by vote of the membership. A very important part of this election process is the Nominating Committee which is responsible for presenting a slate of officers and directors.

The Nominating Committee consists of 18 members, 10 of whom are selected by the Chapters Regional Committees, 6 by the Board of Directors, one selected by the President from the last Nominating Committee, and one Past President. Since nomination in a Society such as ours is almost tantamount to being elected, this Nominating Committee is highly significant. It is wisely arranged to prevent a clique from perpetuating itself.

A most important part of the nominating procedure occurs when the Chapters Regional Committees meet each year and make their selections for 10 members of the Nominating Committee along with suggested candidates for nomination. This puts a heavy responsibility on the delegates to the Chapters Regional Committee meetings. And since the delegates are selected, either directly or indirectly by the members of the Chapters, it effectively puts the long range management of our Society in the hands of the individual members. Herein is our strength.

We may not always make perfect decisions in the right direction, but we can not long continue in the wrong direction. 20,000 members control our Society and it is my belief that they can not be wrong.

That you may enjoy the

Vancouver Meeting

Attending to the details that go into the planning of a successful program for the 67th ASHRAE Annual Meeting at Vancouver, June 13-15, are: (Front Row) R. B. McDonnell, Entertainment Committee Chairman; D. W. Thomson, Reception Committee; A. C. Martin, General Chairman; C. Van Boeyen, Children's Committee Chairman; A. Lewis, Transportation Committee Chairman; and R. Racine, Publicity Committee Chairman. (Second Row) D. B. Leaney, Chapter Vice-President; E. E. Renouf, Golf Committee Chairman; F. Dwyer, Housing Committee Chairman; and P. Snider, Sessions.

Vancouver will offer a social program of impressive proportions. Program being planned will include such special events as a golf tournament, a cruise of the Gulf of Georgia and sight-seeing tours, to mention a few. Activities for the children will be a swim party and trip to Grouse Mountain Ski Lift.

At the Welcome Luncheon on Monday the feature will be the installation of new ASHRAE officers and the announcement of awards.

ECONOMICS OF ODOR REMOVAL AND AIR CLEANERS

(*Continued from page* 43)

dents), report from Saint Louis Park, Minnesota school system; colleges—teachers 3 per cent (students 2 per cent) from college.

Line 11—the dollar cost of absenteeism—is found by multiplying figures in lines 9 and 10.

Line 12—percentage reduction in absenteeism required to pay for an air-recovery system—is found by dividing figures in line 6 by those of line 11. As might be expected, it takes a big reduction in absenteeism to pay for an air-recovery system in a hotel or motel, because the number of employes and wage levels are both low. Conversely, because of the higher salaries in an office building, saving less than 1.5 per cent in absenteeism will pay for an air-recovery system.

Combining cleaning and redecorating expenses and absenteeism costs, the percentage reduction of both required to pay for the air-recovery system is shown in line 13 (dividing line 6 by the sum of lines 7 and 11).

COIL RATING FACTOR AND HEAT EXCHANGERS

(*Continued from page* 52)

surface areas, weights, volumes, etc., using a single abscissa.

5. An additional curve for each heat exchanger provides both a face velocity and face area comparison. These curves are also useful if comparisons at fixed face area but variable pressure drop are desired.

6. Lines of constant friction power per unit surface area are easily included.

Obviously, considerable judgment must still accompany final selection of a heat exchanger. Factors such as casing and header costs, labor costs, dehumidification performance, noise, fouling, and many others must still be evaluated. However, by putting the performance requirements on an equal basis, the problem of making the final selection is simplified greatly.

Central Oklahoma Chapter first to exceed its UEC quota

As an example of what can be done with organized manpower and determination in the furthering of a good cause, we publish herewith a letter from Regional Director-elect (VIII) W. J. Collins, Jr., to ASHRAE's UEC Fund Raising Committee Chairman Merrill F. Blankin. The Central Oklahoma Chapter has just passed its fund raising objective by a generous margin. In fact, most recent figures show 78 members to have contributed a total of $2300, a record to date of 128% of the original goal.

Dear Mr. Blankin:

During your discussion of the United Engineering Center Building Fund at the dinner of the Regions Central Committee in Dallas, you asked me what we had done in Oklahoma regarding the fund. At that time I told you that we had not gotten underway with any program because of the timing – Christmas holidays, Semiannual Meeting, etc. – and that I didn't anticipate that we would actually get underway until March. It is a month since our March Chapter Meeting and I should like to report for the Central Oklahoma Chapter.

On March 7, at our Chapter Board of Governors meeting, we discussed the fund, and what to do about it. The following opinions evolved out of our discussion:

a. Inherently, people are opposed to fund campaigns of any type.
b. The only successful type of fund campaign is one of personal contact.
c. We have an obligation to ASHRAE and to the engineering profession, so therefore a personal contact campaign is necessary.

We did not have an accurate membership tabulation available at that meeting, so we based our plans on a membership of 120. We estimated 10% were inactive (uninterested or not personally known to us by reason of being remotely located from Oklahoma City), so we figured we had 108 members to contact. We set up three teams of six men each – each man to have five members to contact in addition to himself. Surely this would not require too much of anyone's time. We calculated our quota to be $1800, based on 120 members at $15 each.

On March 14, prior to our Chapter meeting, we had a meeting of these 18 campaign workers and distributed pledge cards to them. (During the preceding week we had reproduced cards from your January letter, and had the names and addresses of the members typed on them.) We anticipated a participation of 60% of our total membership, so we figured we had to average $25 for each of 72 participants to reach our goal of $1800.

We suggested that, if asked, members in management positions should be advised that their fair share would be $20 per year for three years or $50 lump sum, and that the fair share for those in employee positions should be half of that. It was emphasized that no pressure was to be exerted in this regard. A brief announcement of the campaign was made at the Chapter meeting.

Actually, we have 115 members according to the national roster, ten of these being in the inactive category, so we had 105 cards to work. The results to date have been amazing – 70 members have pledged $1987.50, of which $1362.50 has been collected, with $625 to be paid in deferred payments. Three members had previously contributed $95, raising our Chapter total pledges to $2082.50. The $15 per member quota would make our Chapter quota $1725, so it looks as if we are well over our quota, and I expect that when the final total is run up that we will be 10% over what is pledged to date.

Some interesting side lights are:

1. Most members expected personal contact and were very willing to contribute.
2. Approximately 10% of the membership contacted said they were "not interested."
3. Three members had contributed substantially through other societies and felt unable to contribute further.
4. Two members had contributed through other societies, but also contributed through our campaign.

I hope to report on all the "stragglers" soon.

Wm. J. Collins, Jr.
Chapter Chairman UEC Fund Raising Committee

For your convenience a contribution pledge form is incorporated within this page. Mail to ASHRAE, 62 Worth Street, New York 13, N. Y.

UEC FUND RAISING COMMITTEE
Merill F. Blankin, *Chairman*
Thomas E. Brewer, *Vice-Chairman*
John E. Haines, *Vice-Chairman*
Clifford F. Holske, *Vice-Chairman*

NAME .....

ADDRESS .....

IN CONSIDERATION OF THE GIFTS OF OTHERS INTENDS TO GIVE TO

UNITED ENGINEERING CENTER BUILDING FUND .

.....DOLLARS $.....

BALANCE TO BE PAID QUARTERLY $....., SEMIANNUALLY $.....

ANNUALLY $....., OR AS FOLLOWS .....

SIGNED.....

MEMBER ASHRAE

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29 WEST 39TH STREET, NEW YORK 18, N. Y.
GIFTS ARE DEDUCTIBLE FOR INCOME TAX PURPOSES

Meetings ahead

June 6-9 – Institute of Boiler and Radiator Manufacturers, Annual Meeting, Absecon, N. J.

June 6-9 – National District Heating Association, 51st Annual Meeting, Asheville, N. C.

June 6-10 – Institute of Appliance Manufacturers, Cincinnati, Ohio.

June 13-15–American Society of Heating, Refrigerating and Air-Conditioning Engineers, 67th Annual Meeting, Vancouver, B. C.

June 15-17–1960 Heat Transfer and Fluid Mechanics Institute, Stanford University, Stanford, Calif.

August 23-25–Sixth Cryogenics Engineering Conference, Boulder, Colo.

October 10-12 – American Gas Association, Annual Convention, Atlantic City, N. J.

October 20-23–Refrigeration Service Engineers Society, Annual Convention, Portland, Ore.

October 25-27 – American Standards Association, 11th National Conference on Standards, New York, N. Y.

October 28-November 2 – Air Conditioning and Refrigeration Wholesalers, Silver Anniversary Convention, SS Hanseatic.

October 31-November 3 – Institute of Boiler and Radiator Manufacturers, Semiannual Meeting, Absecon, N. J.

November 14-17–National Warm Air Heating and Air Conditioning Association, 47th Annual Meeting, Cleveland, Ohio.

November 18-22 – Air Conditioning and Refrigeration Institute, Annual Meeting, Hollywood Beach, Fla.

November 20-23 – Refrigeration and Air Conditioning Contractors Association, Annual Meeting, Miami, Fla.

February 13-16–American Society of Heating, Refrigerating and Air Conditioning Engineers, Semiannual Meeting, Chicago, Ill.

February 13-16–15th International Heating and Air-Conditioning Exposition, Chicago, Ill.

People

Richard W. Evans, President and Treasurer, and **Robert L. Michaud,** Vice President, are principals in a newly formed firm, Evans, Michaud, Cooley, Hallberg & Erickson. Formation of the company was made to continue consulting engineering practice formerly conducted under the name of Richard W. Evans & Associates.

J. P. McShane has been appointed head of the Engineering Div of Swift & Company, a newly-created div combining activities previously handled under the Supervising Engineer and Industrial Engineering Divs. Joining Swift in 1927 after graduation from the University of Texas, he served as Chief Engineer in the Nashville plant, then in Chicago as Assistant Supervising Engineer and Supervising Engineer. He has been a Director of ASHRAE for three terms, was Chairman of the former Chicago Sect of ASRE, and has been actively associated with the development of material for Society publications relating to meat packing plant refrigeration.

Julian H. Blake has joined the newly organized Industrial Refrigeration Div of Ray Winther Company and will head its activities. Bringing to the div a background of almost 19 years' experience in design and installation of industrial and commercial refrigeration systems, he was last associated with Western Engineers, Inc.

William W. Murray, Jr., has been presented with this year's Distinguished Service Award of the Mechanical Contractors Association of America, in recognition of his contributions to the organization. He served as its Director from 1946 to 1955, Treasurer in 1950, Vice President in 1951 and President in 1952. Presentation of the award was made at the society's annual convention. Mr. Murray is President of Almirall & Company, Inc., a contracting firm with which he has been associated for 49 years.

W. K. Roots, until recently Senior Design Engineer for Federal Pacific Electric Company, has been appointed Chief Engineer of Mears Electric Controls, Inc., and Mears Electric Circuit Breakers, Inc. A former project engineer for the Power Authority of the State of New York, he has also served as Manager of Engineering for Canadian Line Materials Div, McGraw-Edison, and Managing Director and Chief Engineer of Pioneer Controls, Ltd.

John B. Koch was Assistant Director of Mechanical Design for American Radiator & Standard Sanitary Corporation's Industrial Div prior to assuming the new post of Director of Engineering for the Kewanee, Ill., plant. An alumnus of the University of Michigan, he joined the Industrial Div in 1936. Besides ASHRAE, he is a member of the American Society of Mechanical Engineers and the Engineering Society of Detroit.

Jasper A. Smith, a past President of Dayton Chapter, was 64 at the time of his death on March 4th. An alumnus of Bradley University, he was a sales engineer for Frigidaire until his retirement three years ago.

John H. Bryce, deceased, was Vice President and Chief Engineer of Joseph Davis, Inc., heating and ventilating contractors. Prominent in local chapter activities, he was President of Niagara Frontier Chapter of the former ASHAE in 1950-51.

Richard E. Zach has joined Canadian Ice Machine Company Ltd. as Chief Engineer. Prior to this appointment he was a lecturer in thermodynamics and refrigeration at the University of Wisconsin and practiced as a consulting engineer. Before that, he served with York Corporation.

Raymond G. Mozley has been named Vice President-Overseas Operations for Copeland Refrigeration Corporation, continuing in his previous capacity as Chief Application Engineer. He has been associated with Copeland since 1952 as Assistant to the Vice President of Engineering, Chief Laboratory Engineer and Chief Application Engineer.

John H. Spence, retired Service Manager of Hussmann Refrigeration, Inc., has been named full-time Educational Director of Refrigeration Service Engineers Society. He has been an honorary member of that Society since 1957.

John R. Michie will be in charge of newly organized Frick of Canada Ltd. in Montreal, Canada. A graduate of the University of Toronto with a degree in mechanical engineering, he has been with Canadian Ice Machine Company, Ltd., since 1940, except for wartime service, and has had extensive experience in refrigeration and air conditioning. In addition to ASHRAE, he is a member of the Engineering Institute of Canada and the Corporation of Professional Engineers of Quebec.

S. R. Hill, in his new position as Senior Staff Engineer in the Commercial-Industrial Sect of Westinghouse Electric Corporation's Air Conditioning Div at Staunton, Va., will be responsible for marketing of commercial packaged cooling equipment up to 30 ton. A University of Oklahoma graduate with a B.S. in mechanical engineering, he was associated with Trane Company from 1948 through 1957, and was a partner in a consulting engineering firm prior to joining Westinghouse.

Frank J. Schneider, with Limbach Company since 1952, has been appointed Manager of the Mechanical Dept. Joining the company as a Superintendent of Pipe Fitting in the Pittsburgh branch, he was Production Manager of that dept prior to his recent appointment. An authority on steamfitter training, he directed development of a new apprentice curriculum and teaching system at the Pittsburgh branch.

John W. Hall is now Sales Engineer of the Solenoid Sect of Marsh Instrument Company Div of Colorado Oil and Gas Corporation. His experience in fields related to solenoid applications includes posts with Mills Industries, Inc., Admiral Corporation and AP Controls Div of Controls Company of America. Past-President of the Illinois Chapter, ASHRAE, and past-Vice President of National Association of Practical Refrigeration Engineers, he is well known as a lecturer.

Lawrence J. Smith, formerly Director of Research, has been advanced to the position of Vice President in Charge of Research at Bell & Gossett Company. Joining the organization in 1930 as Chicago Field Engineer, he was named Director of Research in 1943. Prior to joining Bell & Gossett, he was an engineer with Underwriters Laboratories.

W. E. Weber is now Pacific Coast Div Manager for A. M. Byers Company, succeeding **A. D. Sheere,** who retired recently after more than 36 years with the organization. A graduate of St. Bonaventure College, Weber joined Byers in 1950, serving four years at the Ambridge plant and five years on the west coast as field service engineer.

W. F. Foster, joining the Div as Chief Product Engineer of Air Conditioning Products, and **B. W. Reid,** named Sales Manager of the Heating and Cooling Coil Dept, are ASHRAE members assuming new positions with the Danville Div of Bohn Aluminum and Brass Corporation.

Blake Ward advances to the position of St. Louis Div Manager of A. M. Byers Company from that of Field Service Engineer. Prior to joining Byers in 1946, he was a sales representative for Lever Brothers Company and Air Reduction Sales Company.

Others are saying——

that . . . . . design outside temperatures for comfort conditioning do not properly apply to cooling greenhouses. Evaluation of outdoor design temperatures for this purpose is based on use of a greenhouse design temperature which must not be exceeded, even under the most severe conditions. In effect, this means that outdoor temperatures used for system design must be the most severe recorded values, available from weather records. *Air Conditioning, Heating and Ventilating, April 1960, p 76.*

that . . . . . Equatorial Comfort Index, as evaluated by means of a nomogram presented in this article, is the temperature of still and saturated air which is assessed to have the same effect on human comfort as the measured climate. It is cited as being an improved version of the Singapore Index, which was calculated from more restricted data, and as having a wider range of applicability. Both indices agree at 78 F. *Journal of the Institution of Heating and Ventilating Engineers, January 1960, p 297 (British).*

that . . . . . many notions held without sufficient experimental basis because they seemed to be in line with common sense and subsequently proven untrue are still to be found in textbooks. Examples cited include the acceptances that the coefficient of per-

(*Continued on page* 84)

There was an unfortunate and inadvertent omission from the President's Page of the April issue of the JOURNAL, as guest sponsored by Honors and Awards Committee Chairman W. L. Holladay, of the Honorary Membership status of Dr. Arthur Cutts Willard, President Emeritus of the University of Illinois. Dr. Willard was made an Honorary Member of ASHAE in 1957 and of course is now one of ASHRAE. At that time the citation referred to his world-wide reputation in heating and ventilating research. A pioneer in warm-air heating, it was through his efforts that a residence for research purposes was constructed at the University.

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Western Air Conditioning Show

is paralleled by three-day technical conferences

Four days of comprehensive specialized sessions highlighted the Western Air Conditioning, Heating, Ventilating and Refrigeration Exhibit and Conference held at Shrine Exposition Hall, Los Angeles, April 27-30, 1960.

Sponsored by Western Air Conditioning Association under the direction of Vice President Arthur J. Hess, also Past President of ASHRAE, the program was divided into three parts: an Engineers' Day, Contractors' Day and Practical Applications Day.

Engineers' Day featured a clinic for Junior Engineers on fan auxiliary equipment with discussions and lectures on selection of fan drives for maximum ultimate efficiency; and the study of vibration control of equipment.

On Contractors' Day, there were technical sessions for Wet Heat Contractors on piping connections for steam and hot water boilers and a Sheet Metal Contractors session on high velocity duct systems. E. L. Nelson, ASHRAE Member, was chairman for the clinic on temperature control systems.

Practical Applications Day indicated advance methods of air conditioning installation. A symposium on "Piping" was presented with ASHRAE Member, Henry Ulovec, acting as Chairman.

Special meetings included discussions and talks on rapidly changing techniques in: Hospitals . . . control of air borne infections; Schools . . . preparation for future air conditioning; Hotels . . . importance of ventilation in air conditioning; Residences . . . heat pumps and gas cooling. Chairman D. D. Wile, President of ASHRAE, was panel moderator for "Condensing Methods." ASHRAE Member John Engalitcheff and ASHRAE Fellow W. L. Holladay participated.

A panel discussion moderated by C. D. Walz, ASHRAE Member, between an architect, contractor, salesman and a manufacturer covered specification writing. There was a symposium on methods of cooling, encompassing absorption refrigeration, natural gas driven refrigeration and heat pumps.

"Lighting Loads in Office Buildings" was the topic of a technical talk by C. B. Gamble, ASHRAE Member. On these programs new and changing techniques taking place in the industry were emphasized and explained. Exhibits featured recent developments well-adapted to use in various geographic locations.

What ASHRAE Regions and Chapters are doing

Discussions of a variety of heating and cooling methods, including thermoelectricity and solar and nuclear energy, are featured in spring meetings. Elections of new officers are held by several Chapters.

JOHNSTOWN . . . Recommendation of the Nominating Committee was for the following as officers for the 1960-61 season: J. K. Thornton, President; G. C. MacAlarney, Vice President; C. Barnhart, Secretary; J. Sobieski, Treasurer; and Lewis Straw, E. S. Spangler and S. Moroh, Board of Governors.

Activities of the Better Heating-Cooling Council were discussed by the April speaker, Franklin Green, Director of the Council, who quoted from interviews made by the group to determine residential heating and cooling needs from the basis of the housewife.

NEW ORLEANS . . . Nominating Committee has submitted the following slate of officers for the new season: E. H. Sanford, President; J. H. Maloney, Vice President; R. D. Lewis, Treasurer; Waring Green, Secretary; and J. F. Albright and J. I. Hebert, Jr., Board of Governors.

Members attending the April 19th meeting heard an address by Bruno B. Morabito, Application Engineer with Carrier Corporation, "Higher Cooling Coil Water Differentials and Overall System Economies." By designing a system with a 15 F water temperature rise rather than the normal 10 F, lower costs in several areas were cited as being attained: lower basic cost of the equipment and lower total operating brake hp and kw input, plus more efficient all-around operation resulting in lower operating costs. This trend is continued through reduced cost of the piping system resulting in savings on the water side of the equipment, with the air side being similarly affected. Lower costs there derive from use of smaller ductwork and therefore less insulation, smaller filters and lower required fan capacity and input motors.

CLEVELAND . . . Members attending the April meeting heard a three-member panel discussion of temperature control. Covering control of 100% outside air makeup units, Lloyd Burkes, President of Slawson Equipment Company, stressed the need for steam distributing type coils or, on a hot water job, addition of a separate circulator and piping of a three-way valve for continuous flow of water through the coil. He also emphasized the need for reset of the discharge controller as outside temperatures vary.

Hugh MacNair, Minneapolis-Honeywell Regulator Company, discussed control of a multi-zone unit, emphasizing the need for proper arrangement of outside and return air ductwork to minimize air stratification. Necessity for steam distributing type coils or a hot water system piping a separate circulator and three-way valve for continuous flow was also emphasized by him. Better control will result if the hot deck temperature is reset from outside air, he contended.

Stating that control centers can reduce the operating cost of both small and large buildings, Richard Wilson of Johnson Service was final member of the panel to speak. His contention was that centralization of numerous functions of indication in control, such as temperature, flow, start-stop, boiler safety and other arms and inter-communication can save manpower, fuel and electrical power costs.

PUGET SOUND . . . Elected to office for the 1960-61 season were: M. R. Overbye, President; K. C. Massart, 1st Vice President; R. R. Kirkwood, 2nd Vice President; David Hopkins, Secretary; D. J. Moore, Treasurer; and Dixon Erwin and Henry Bickel, Board of Governors.

Speaker of the evening was Daniel B. Callaway of Industrial Acoustics, who presented a talk on "Noise Control for Air Distribution Systems."

RICHMOND . . . Delivered at the April 4th meeting was a talk by Dr. Mearl A. Kise, Director of Research and Development for Virginia Smelting Company, on water treatment. His address was cautionary, advising that every case of contamination is different, even though the installations may be side by side, and that they should be approached and treated with common sense. One-shot treatments should be investigated before use.

HOUSTON . . . Submitted by the Nominating Committee as candidates for office in the 1960-61 season are: J. R. Jones and E. E. Ransom, Jr., Presi-

CHAPTER MEETING DATES

	June
Alamo	21
Arkansas	15
Atlanta	—
Austin	16
Baltimore	—
Baton Rouge	—
Boston	—
British Columbia	—
Central Arizona	—
Central Indiana	—
Central Michigan	14
Central New York	—
Central Oklahoma	—

	June
Central Pennsylvania	—
Cincinnati	—
Cleveland	—
Columbus	—
Dallas	20
Dayton	—
El Paso	—
Evansville	4
Florida West Coast	21
Fort Worth	15
Golden Gate	2
Hampton Roads	10
Houston	17

	June
Illinois	—
Illinois-Iowa	—
Inland Empire	14
Iowa	—
Jacksonville	—
Johnstown	—
Kansas City	—
La Ville de Quebec	13
Long Island	13
Louisville	—
Manitoba	—
Memphis	—
Michigan	—

dent; E. H. McLane and J. M. Daniel, 1st Vice President; J. B. Buckley and C. H. Jochen, 2nd Vice President; T. W. Leatherwood, Secretary; J. E. Burton, Treasurer; and Morris Backer and H. E. Conley, Board of Governors.

John T. Ames was speaker of the evening at the April 13th meeting, discussing "The Modern Ice Age." As Senior Engineer for Natkin & Company, he supervised a project at Thule Air Force Base in Greenland. Showing slides of this project, he narrated points of interest and indicated problems encountered on this assignment.

BRITISH COLUMBIA . . . Presenting his talk in three parts, Dan Callaway of Industrial Acoustics Company spoke at the April meeting on "Silencing and Sound Deadening in Air Conditioning Systems." His speech covered basic acoustical concepts, present state of engineering knowledge of acoustics in air handling systems and a shortcut form to analyze noise problems in such systems.

NORTH JERSEY . . . New officers of this Chapter, as announced at the April 14th meeting, are: George Freeman, President; C. E. Parmelee, 1st Vice President; Herbert Wolf, 2nd Vice President; C. Zimmer, Secretary; L. Lieberman, Assistant Secretary; and B. Taylor, Treasurer.

NEW YORK . . . Presenting information currently available on thermoelectric refrigeration, Lloyd A. Staebler of Philco Corporation, assisted by Dr. Peter Taylor of the same company, was guest speaker at the April 26th meeting. Included in his remarks were a description of the thermoelectric refrigeration cycle with analogies to the familiar compression refrigeration cycle and a discussion of design problems encountered in this field, based on data obtained from present applications.

ILLINOIS . . . Advantages of various types of fans were covered in a slide-illustrated talk presented by C. Jack Trickler, Chief Engineer of New York Blower Company, speaker at Session No. 1 of the April 11th meeting. Shown by him were steeply rising brake hp of a forward curved blade fan, based on an increase of cfm, and how the brake hp curve rises more slowly with a backwardly inclined blade fan.

Several slides were shown to illustrate incorrect duct connection to fan intakes and decrease in fan air handling capacities based on these connections. Minimum or no duct connections usually are best for highest efficiency. Also covered were parallel blade or opposed blade dampers in the fan discharge, as well as vortex dampers in fan suction used for throttling fan capacities.

At Session No. 2 of the meeting a five-member panel discussed "Ammonia vs Halogenated Hydrocarbon Refrigerants," resulting, in the estimation of J. Kronholz of York Corporation, organizer of the discussion, in favor of ammonia.

C. L. Rescorla of York Corporation keynoted the comparative thermodynamic properties in areas where there is a choice based on economic reasons for choosing between ammonia and halo-carbons. Emphasis was put, by Niederer of Refrigeration Appliances, on different effects that each refrigerant has on evaporator design and performance. Little known features differentiating the design of ammonia expansion valves as compared to halo-carbon expansion valves were discussed by William Richards, H. A. Phillips & Company. Covering the practical aspects of piping and oil return problems, Gene Rytlewski, Ball Ice Machine Company, spoke on the importance of proper pipe sizing on a reasonable velocity basis rather than on a max permissible pressure drop basis. He also pointed out common and uncommon mistakes in collection and return of oil. Finally, Tony Theis of Theis Refrigeration Company related various viewpoints of contractors and how different refrigerants present quite different supervision and installation difficulties.

OREGON . . . Subject of an address at the April 14th meeting, presented by Daniel B. Callaway of Industrial Acoustics, was "Noise Control for Air Distribution Systems." Included in his talk were description of the various possible paths which sound takes from the source to the observer, definition of terms used in this field, factors modifying the noise source, tracing through a method along one path and description of a short form together with its limits in accuracy.

MEMPHIS . . . Gil Carson of Bell and Gossett Company, speaking on "High Temperature Water" at the April 18th meeting, emphasized medium temperature water and the use of greater temperature drops in low temperature systems. A major point brought out in his talk was the question of a 20 F temperature drop. When hot water heating was first initiated, it was used mainly in residential work and was designed by sales and building per-

	June
Middle Tennessee	—
Minnesota	—
Mississippi	27
Mobile	27
Montreal	13
National Capital	—
Nebraska	—
New Mexico	21
New Orleans	—
New York	—
Niagara Peninsula	7
North Alabama	—
North Jersey	2
North Piedmont	—
Northeastern New York	—
Northeastern Oklahoma	—
Northern Alberta	9
Northern Connecticut	—
Northern Ohio	—
Ontario	—
Oregon	2
Ottawa Valley	—
Panama & Canal Zone	14
Philadelphia	14
Pittsburgh	—
Puget Sound	—
Rhode Island	—
Richmond	—
Rochester	—
Rocky Mountain	—
Sacramento Valley	1
St. Louis	—
San Diego	14
San Joaquin	21
Savannah	14
Shreveport	16
South Carolina	20
South Florida	14
South Piedmont	—
Southern Alberta	—
Southern California	13
Southern Connecticut	14
Toledo	—
Tucson	—
Utah	17
West Texas	27
Western Massachusetts	—
Western Michigan	—
Wichita	—
Wisconsin	—

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sonnel. The calculation, one gpm equals 10,000 Btu/hr was simple, and the inherent safety factor in a 20 F drop system minimized the chances of a system not working. These reasons are no longer sufficient, besides the fact that savings on a system using a 60 F drop would be significant. In the question and answer period following the discussion, it was indicated that in some cases, such as with baseboard and continuous finned tube radiation, a low temperature drop must still be used.

SOUTHERN CALIFORNIA . . . "Recent Developments in Thermoelectricity and Principles of Design and Application" were discussed by Charles J. Frank of Westinghouse Electric Corporation at the April meeting. It was explained that the Seebeck effect is obtained by applying heat to a semiconductor to produce an electrical current. Three basic requirements for material for this effect are: good electrical conductivity, high thermoelectrical voltage and poor heat conductivity.

Reverse of this, the Peltier effect, is heating or cooling obtained through application of electrical current to a semiconductor. The Peltier effect is reversible depending upon the direction of the current. Material for this has four requirements: ability to withstand high temperature, good electrical conductivity, high thermoelectrical voltage and poor heat conductivity. Thermoelectricity has a practical efficiency of 30%, but present development has only reached an efficiency of 12%, according to the speaker. Most development has been done on equipment in sizes from a few Btu/hr to several hundred.

PANAMA & CANAL ZONE . . . Four speakers were featured at the April 20th meeting: Roy Stephens, speaking on the growth of the air conditioning industry; James Byers on air conditioning control systems; R. G. Fifer on air conditioning and its effect on work production in offices; and Henry W. Critch on maintenance problems of equipment resulting from crowded installations and lack of service facilities such as electrical outlets and water.

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Role of package steam and hot water generators was discussed at the April meeting by W. T. Gardiner of Crane Company's Cyclotherm Div. Outlining the history of package generators, he stated that they first began to be in great demand in 1940. Package boilers are generally in the class of 500,000 to 26,000,000 Btu/hr output. A film was shown depicting manufacturing procedure.

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WISCONSIN . . . Problems of solar heating and cooling were covered from both an engineering and economic standpoint by the April speaker, Dr. John A. Duffie of the University of Wisconsin. Supplementing his talk with slides, he showed a schematic diagram of a solar heating system, indicating that major components of the system were collectors, storage bed, air ducts and blowers. Collectors are usually glass panels set at a 45 deg angle from the horizontal and act to transmit the sun's energy to a storage bed such as a rock pile. This energy, when required, is then delivered by means of the blowers and air ducts to the area where it is needed. Economically, solar plants are not practical at the present time.

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Three Chapters Regional Committee Meetings, one coupled with a Regional Conference, were held in May by Regions VIII, IX and X. Featured at all meetings was a speech by ASHRAE President D. D. Wile, "20,000 Members Can't Be Wrong" (see President's Page, this issue).

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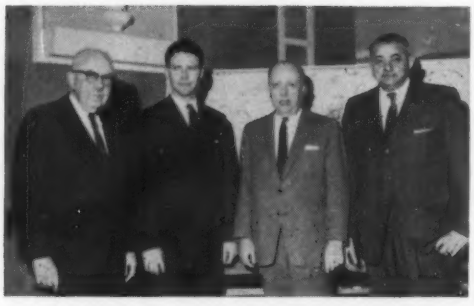
(*Continued on page* 87)



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(*Continued on page* 87)

Candidates for ASHRAE Membership

Following is a list of 108 candidates for membership or advancement in membership grade. Members are requested to assume their full share of responsibility in the acceptance of these candidates for membership by advising the Executive Secretary on or before June 30, 1960 of any whose eligibility for membership is questioned. Unless such objection is made these candidates will be voted by the Board of Directors.

Note: * Advancement † Reinstatement

REGION I

Massachusetts

GALLAGER, F. E., Cons. Engr. Salem.
LECHNER, W. L., Design Engr., Reardon & Turner, Boston.

New Jersey

MCKIERNAN, J. D., Engr., Curtiss Wright Corp., Wright Aeronautical Div., Woodridge.
SEAL, A. T.,† Design Engr., Vogelbach & Baumann, Scotch Plains.
SHALLOW, T. A.,†, Engr., International Electric Corp., Paramus.

New York

BOHLMAN, J. W., Dist. Mgr., Cleaver Brooks Co., New York.
COUGHLIN, R. J.,†, Lab. Tech. Specialist, International Business Machines Corp., Yorktown Heights.
DAVIS, P. E., Repr., Behrer Nason Co., Inc., Mineola.
FOX, R. F.,†, Sales Engr., York Corp., Rochester.
GREENBERG, A. G., Design Engr., Voorhees Walker Smith Smith & Haines, New York.
KAUFMAN, J., Owner, Jesse's Refrigeration Service, Brooklyn.
MAHLUM, A. W., Sales Engr., Powers Regulator Co., Syracuse.
MARKEL, M. L., Vice-Pres., Markel Electric Products, Inc., Buffalo.
MCCLIVE, J. R., Sales Engr., Buffalo Forge Co., Buffalo.
ROTHSCHILD, G. M., Design Engr., Voorhees Walker Smith Smith & Haines, New York.
SIMPSON, E. H.,†, Asst. Chief Mech. Engr., John Graham & Co., New York.
SMERCAK, J. E., Proj. Engr., Voorhees Walker Smith Smith & Haines, New York.
THOMPSON, R. H.,†, Engrg. Design II, Port of New York Authority, New York.

REGION II

Canada

ATTWOOD, J. L.,* Chief Engr., Beaver Engineering Co., Toronto, Ont.
BOURSSA, J. F., Engr., Andre Gilbert Engineering Co., Quebec.
CHERITON, W. R., Engr., Canadian Engineering Surveys Ltd., Edmonton, Alta.
CHESTER, I. H., Mech. Engr., Moody Moore & Partners, Winnipeg, Man.
CURRIE, J. R., Br. Mgr., Sheldons Engineering Ltd., Hamilton, Ont.
DUBEAU, J. P., Control Engr., Powers Regulator Co. of Canada Ltd. Quebec.
GREEN, S. H., Sales Mgr., A-C. Div., Superior Roofing & Ventilation Co., St. Boniface, Man.
HILTON, C. H., Design Engr., Trane Co. of Canada Ltd., Toronto, Ont.
KHAN, F. A. M., Mech. Engr., Moody, Moore & Partners, Winnipeg, Man.
LAPIERRE, A., Mgr., Indus. Div., Mongeau & Robert Cie Ltee., Montreal, Que.
LEFRANCOIS, D., Engr., Adelard Laberge Ltee., Quebec.
MOCKFORD, D. W. J., Design Engr., Crowther, MacKay & Assocs., Ltd. Edmonton, Alta.
MOODY, M. J., Sales Engr., KeepRite Products Ltd., Brantford, Ont.
NOREAU, Y., Designer, Wood, McAdam & Magor, Montreal, Que.
SIMON, R. P., Sales Repr., E. T. Sampson & Co., Ltd., Toronto, Ont.
SIMS, G. E., Br. Mgr., Wells H. Morton & Co., Ltd., Edmonton, Alta.

WHO'S WHO IN ASHRAE

Insofar as possible, these listings will each appear twice a year

ASHRAE OFFICERS, COMMITTEES
See page 62, this issue

REGION AND CHAPTER OFFICERS
See page 90, May JOURNAL

RESEARCH AND TECHNICAL COMMITTEES
See page 74, February JOURNAL

STANDARDS COMMITTEE
See page 89, November JOURNAL

INTER-SOCIETY COMMITTEES
See page 66, February JOURNAL

SMITH, W. A., Gen. Mech. Supt., Burns & Co., Ltd., Calgary, Alta.

REGION III

Delaware

FILLIBEN, J. F., Jr., Sr. Mech. Engr., E. I. DuPont De Nemours & Co., Inc., Wilmington.

Pennsylvania

HOEY, J. B., Sales Supvsr., Peoples National Gas Co., Ebensburg.
KIRMSE, W., Proj. Engr., Williard Inc., Philadelphia.
SEBRING, R. D., Sales Repr., Wolverine Tube, Div. of Calumet & Hecla, Inc., Pittsburgh.
VERVERELLI, D. J., Design Engr., Moody & Hutchison, Philadelphia.

Virginia

LUMSDEN, C. H., JR., Owner, Sheet Metal Specialty Co., Norfolk.

REGION IV

Florida

SCHUMAKER, E. P., Htg. & A-C. Engr. Houston Corp., Miami.
STAFFORD, H. D., Sales Engr., Johnson Service Co., Jacksonville.

Georgia

CALHOUN, W. E., Estimator, Norris & Co., Atlanta.
FAULKNER, E. O.,†, Sales Engr., Leo S. Bosarge Co., Atlanta.
SELBY, S. A., Jr., Assoc. & Mech. Engr., James C. Wise, Simpson, Aiken & Assocs., Inc., Atlanta.
WRIGHT, J. T., Sales Repr., Graver Refrigeration, Atlanta.

North Carolina

NAGEL, E., Mgr. Research Dept., Pneumafil Corp., Charlotte.

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BERNARD, J. A. R., Br. Com. Mgr., Minneapolis-Honeywell Regulator Co., Columbus.

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KARL, L. G., JR., Mgr., R & S Sheet Metal, River Rouge.

METZGER, R. G., Field Engr., Texas Instruments, Inc., Metals & Controls Div., Grand Rapids.

PEDERSEN, R. A., Sales Engr., D. T. Randall & Co., Ferndale.

WHITE, D. E., Resident Engr., Levin, Pierce & Wolf, Flint.

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EISENBEIS, E. C., Product Designer, General Electric Co., Buechel.

KNIGHTS, C. R., Sales Engr., Barber-Colman Co., Louisville.

MARQUART, J. R., Sales Engr., Texas Instruments Inc., Metals & Controls Div., Louisville.

Louisiana

GRAVES, J. O., Contr. Engr., McCarty-Branton, Inc., Baton Rouge.

STORER, H. E., Sales Engr., Trane Co., New Orleans.

Tennessee

LLOYD, D. L., Mech. Engr., Allen & Hoshall, Memphis.

TREADWAY, W. A., Asst. Htg. & A-C., Nashville Gas Co., Nashville.

TUDOR, J. F., Sales Mgr., Trane Co., Nashville.

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DAVIS, J. E., Factory Repr., American-Standard, Dallas.

ERICKSON, O. M., Business Mgr., Mechanical Contractors Association, Dallas.

PARISH, T. H., Sales Engr., Buffalo Forge Co., Houston.

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KERR, E. A., JR., Sales Engr., York Corp., Denver.

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BRODERICK, W. T., Sales Engr., Minneapolis-Honeywell Regulator Co., San Francisco.

CASTANEDA, O. O., Design Draftsman, West America Engineering Co., San Francisco.

CROZIER, R. R., Sales Engr., G. J. Yamas Co., Inc., San Francisco.

HORN, R. A., Designer, Western Air & Refrig. Co., Inc., San Francisco.

KABANNI, MAHMOUD, Mech. Engr., Stockly & Bamford, Los Angeles.

KAUNOFF, G. V., Asst. to Mech. Engr., West America Engineering Co., San Francisco.

MCJUNKIN, E. A., Partner, Vandament & Darmsted, San Francisco.

ROSS, R. B.,† Dist. Mgr., Armstrong Contracting & Supply Corp., Los Angeles.

SCAVINO, A. V.,* Contract Engr., Powers Regulator Co., Los Angeles.

SHERIFF, ALEX,* Chief Engr., Stanley Feuer Co., Los Angeles.

SMITH, JAMES A., Mfrs. Repr., Cooling & Heating Engineers, Inc., San Francisco.

Oregon

CURTSINGER, L. P.,* Htg. & A-C. Consultant, L. P. Curtsinger, Inc., Eugene.

FORD, DONALD, Pres., East Portland Heating & Ventilating, Inc., Portland.

Washington

COOK, C. A., Mech. Engr., U.S. Government, 5040th Inst. Eng. Office, Seattle.

FRY, W. F., Owner, Thermal Supply Co., Inc., Spokane.

GABLIN, K. A., Sales Engr., Trane Co., Seattle.

YOROZU, A. S., Research Engr., Boeing Airplane Co., Renton.

Philippines

LAGMAN, A. B., Design Engr., Aircon Inc., Manila.

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DUQUÉ, V. G., Appl. & Sales Engr., Trane Co., Brussels.

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ARIAS, F. M., Research, Instituto Nacional De Leforma Agraria, Havana.

England

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BELLAVITIS, CLAUDIO, Tech. Mgr., Marelli Aerotecnica, Milan.

BUSSOLATI, VITTORIO, Cons. Engr., Milan.

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PINZANI, FERDINANDO, Comm. Mgr., Giuseppe de Micheli & Co., Firenze.

India

BROWN, E. F., Appl. Engr., U. K. Ministry of Works, U. K. High Commission, New Delhi.

Malaya

CHING, T. S., Engr., Henry Waugh Ltd., Kuala Lumpur.

South Australia

WILLMETT, J. F., Sr. Sales Engr., Carrier Air Conditioning PTY., Adelaide.

STUDENTS

BORREGO, H. A., New Mexico State University of Agriculture, Engineering and Science, University Park, N. M.

FERGIN, R. K., New Mexico State University of Agriculture, Engineering and Science, University Park, N. M.

SHUSTER, GERHARD, University of Toronto, Ont., Canada.

WAHNON, JAIME, Massachusetts Institute of Technology, Cambridge.

ASHRAE NATIONAL MEETINGS AHEAD	1960	1961	1962	1963
	June 13-15 Annual Vancouver, B.C.	Feb. 13-16 Semiannual Chicago, Ill.	Jan. 28-Feb. 1 Semiannual St. Louis, Mo.	Feb. 11-14 Semiannual New York, N. Y.
		June 26-28 Annual Denver, Colo.	June 18-20 Annual Miami, Fla.	

ASHAE Code Becomes

ASHRAE Standard 45-55

A. T. BOGGS, III

ASHRAE Technical Secretary

One of the major activities of the Standards Committee since the merger of ASHAE and ASRE is a review of existing and proposed standards of the precedent Societies. One of the most recent codes that had been developed by ASHAE has been added to our publications list. This code, now designated ASHRAE Standard 45-55, covers the testing and rating of **heavy-duty furnaces and direct-fired unit heaters.** This standard is applicable to forced warm air furnaces and direct-fired unit heaters having output ratings in excess of 250,000 Btuh and designed for use with various solid, liquid, or gaseous fuels interchangeably or with a single fuel for commercial, industrial, or heavy-duty use. This standard also includes definitions, rating limits, testing equipment, testing procedure, and rating procedure. Copies are available through the Sales Department at 50c each.

Nema: A recent press release indicates availability of Nema publication HU1-1960, **Industrial Heating Units and Devices.** This standard covers cartridge, tubular, strip, immersion, and tubular-type, water-immersion heaters. Copies are available from the National Electrical Manufacturers Association, 155 East 44th Street, New York 17, N. Y., at 30c each.

Govt.: The standard **Simplified Practice Recommendation R207-60, Pipes, Ducts, and Fittings for Warm Air Heating and Air Conditioning Systems** may be obtained from the Superintendent of Documents, Washington 25, D. C., at 15c per copy. This new standard covering kinds and sizes of pipes, ducts, and fittings for warm air heating and air conditioning systems has been released by the Commodity Standards Division, OTS, U. S. Dept. of Commerce. A recent survey by the Air Distribution Institute is the basis for the standard which is a revised edition of the 1956 issue. It lists the kinds and sizes of prefabricated pipes, ducts, and fittings in greatest demand by the building trade today. This standard will serve as a guide for builders, suppliers, and the general public in the utilization of readily-available stock items according to generally recognized trade products.

ASA: B5. 10-1960, **Machine Tapers:** A new revision of this American Standard has been approved by ASA and published by ASME. The standard establishes American Standard practice for the slope of self-holding and machine tapers, the detailed dimensions for this type of taper tool shank, and the corresponding dimensions for the taper socket in the spindle of the machine, including the dimensions of the keyway. The standard now includes tolerances of the rate of taper and more complete data for plug and ring gage data for self-holding tapers and steep machine tapers. Copies are available at $2.50 each from ASA or the American Society of Mechanical Engineers, 29 West 39th Street, New York 1, N. Y.

IEC: ASA release indicates availability of a new international standard recommendation for dimensions and output ratings of electric motors. This recommendation has been published by the **International Electrotechnical Commission.** The IEC is the coordinating body for international standards in the field of electricity and electronics. American interests in the work of IEC are represented by the U.S. National Committee of IEC, an arm of the ASA. IEC publication 72-1 concerns foot-mounted a-c induction motors with shaft heights between 2⅝ and 12½ inches, voltages up to 600 volts and frequencies of 50 and 60 cps. This publication includes tables of standard dimensions, shaft extensions, and output ratings for these motors. Publication 72-1 constitutes the first part of Publication 72 and concerns the standardization of those dimensions of electric motors that affect interchangeability. The second part of Publication 72 dealing with flange-mounted motors is in preparation and will be issued later. Copies of Publication 72-1 are available at $2.40 each from ASA.

Z21.10.1-1959: American Standard **Approval Requirements for Gas Water Heaters** has been approved by ASA and published by AGA. This standard applies to all but side-arm type water heaters having input ratings less than 50,000 Btuh. Side-arm type water heaters are covered by Z21.10.2-1959, American Standard **Approval Requirements for Gas Water Heaters, Side-Arm Type.** This standard applies to side-arm heaters with input ratings less than 50,000 Btuh and designed for use with auxiliary storage systems for domestic service. These new American Standards are intended to cover design, fabrication, and performance requirements of the water heaters covered for fuel gases such as natural gas, manufactured and mixed gases, liquefied petroleum gases, or LP gas-air mixtures. Copies of these standards are available at $2 each from the American Standards Association, 10 East 40th Street, New York 16, N. Y.

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BULLETINS

Steam and Water Manual. Intended chiefly as a guide to selection of automatic heating and cooling coils, the "Engineer's Manual on Steam and Water Service" presents typical examples and offers workable systems to solve certain control problems. A technical directory on the back of each of the 22 data sheets lists additional material available. Applications covered include domestic hot water, fuel oil heaters, heat exchangers for cooling, instantaneous heat exchangers, jacket water cooling, pressure reducing, storage heaters and two-temperature hot water systems.
Powers Regulator Company, 3434 Oakton St., Skokie, Ill.

Foam Pipe Insulation. Thermal, mechanical and chemical properties of Gem-Foam, a low temperature pipe insulation molded of polyurethane foam for service between absolute zero and 250 F, and Gemfil, a foam-in-place polyurethane insulation for use on flanges, valves and fittings, are described in four-page Bulletin J-650. Thermal conductivities of the materials are shown graphically. Discussed are Gem-Foam's workability, mechanical strength, resistance to thermal shock and flame vapor and chemical resistance. A table recommends thicknesses for various temperature ranges. Illustrated application instructions and suggested specifications are also given.
Baldwin-Ehret-Hill, Inc., 500 Breunig Ave., Trenton 2, N. J.

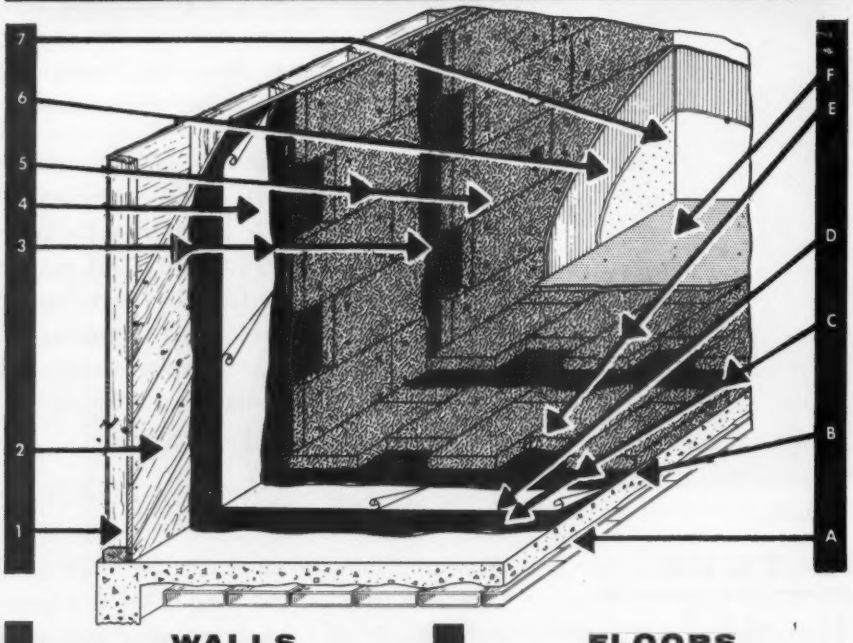
Humidity Control Units. Cited for the 30 sizes (cfm range 668 to 32,250) in the SCD sprayed coil humidity control unit line are such features as modular construction, space for ten row coils to cool and reheat, an integrally-mounted pump in spray section and automatic float valve for automatic water make-up. Flyer SCD 331.01 presents specification data, cutaway illustration, dimensional drawings and product highlights.
Drayer-Hanson Div, National U. S. Radiator Cororation, 3301 Medford St., Los Angeles 63, Calif.

Industrial Fans. Included in the engineering handbook section of Bulletin IF-100 are air volume tables, corrosion data, drying temperatures for a variety of processing requirements, piping information and necessary information for a mechanically sound exhaust and blower system. In addition to this section, the bulletin illustrates the manufacturer's new line of general industrial fans. Data on 17 wheel sizes are included. Capacity tables show static and mechanical efficiencies of air and material handling fan wheels at each point of rating.
General Blower Company, subsidiary of Ilg Electric Ventilating Company, Morton Grove, Ill.

Production Chilling Equipment. Large capacity production chilling equipment for stabilization of metals, stress relief of castings, dehydration of gases and other applications is described in a flyer. Temperature ranges of the low temperature chambers are to −150 F, with thermal capacities from 500 to 10,000 Btu/hr.
Cincinnati Sub-Zero Products, 3930 Reading Rd., Cincinnati 29, Ohio.

Sound Control Curb. Contained in four-page Bulletin 60-SC are details and specifications on QT Sound Control Curb, a pre-fabricated self-flashing unit designed to replace conventional power exhauster curbs. It is cited as reducing an exhauster's sound power at inlet by 90%, but reducing

LAYKOLD PRODUCTS SEAL, HOLD AND PROTECT INSULATION ON THIS TYPICAL JOB



WALLS

1 **WOOD STUDS**
2 **WOOD SHEATHING**
3 **LAYKOLD INSULATION ADHESIVE**
Brush or spray at 23 sq. ft. per gallon. Allow to set (turn black) then press on membrane or blocks
4 **VAPOR BARRIER MEMBRANE**
Press into adhesive. Use 3" laps; 1 to 3 layers.
5 **INSULATION BLOCKS**
When first layer has been placed, set skewers and repeat for next layer of insulation.
6 **LAYKOLD MASTIC WEATHERCOAT**
Point joints and trowel scratch coat at 8 sq. ft. per gallon. Let dry.
7 **LAYKOLD WEATHERCOAT**
Trowel at 15 sq. ft. per gallon for water-resistant finish.

FLOORS

A **TILE OR GRAVEL FILL**
For ventilation vs. freezing of the sub-grade.
B **CONCRETE SUB-SLAB**
If new, use Hydropel integral admix at 1½ gallons per sack of cement. Gives a dry slab.
C **LAYKOLD INSULATION ADHESIVE**
Spray, brush or squeegee at 23 sq. ft. per gallon. Let set (turn black). Then press on membrane and block insulation.
D **VAPOR BARRIER MEMBRANE**
Press into the adhesive. Use 3" laps—1 to 3 layers.
E **INSULATION BLOCKS**
F **2" LAYKOLD HEAVY DUTY FLOOR MASTIC**

Get all the facts on the Laykold Line of products for cold insulation construction from our nearest office.

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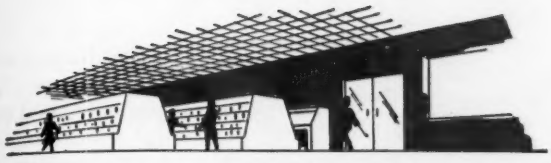
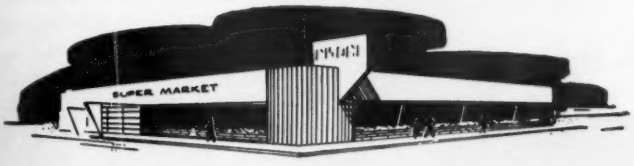


INSTALL IT INDOORS



INSTALL IT OUTDOORS

The McQuay "AL" AIRCON air cooled condenser provides the ultimate in flexibility by combining refrigerant condensing with heating and ventilating. You can utilize condenser heat for heating, and this AIRCON may also be used for exhaust ventilation, saving both time and money in installation, maintenance and operating costs.

"AL" AIRCON is compactly designed, and because of a very low silhouette, will not detract from the appearance of a building when roof mounted . . . the largest model is less than 4½ feet high, unnoticeable from the street.

"AL" AIRCON condensers are available in 8 different fan discharge arrangements and in 16 different unit arrangements . . . all standard. Each condenser coil is factory circuited in single or multiple sections to meet specific requirements of either air conditioning or refrigeration applications. Contact your nearest McQuay representative, or write McQuay, Inc., 1606 Broadway Street N. E., Minneapolis 13, Minnesota.

utilize condenser heat with this low silhouette blower type

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air moving efficiency only 10%. Included in the bulletin are performance graphs, mounting drawings and dimensions for all eight models.
Jenn-Air Products Company, Inc., 1102 Stadium Drive, Indianapolis 7, Indiana.

Heavy Duty Coils. Illustrating and describing this line of coils for steam, steam listribution and hot water is 44-page Bulletin B-1518. Following a general description of the coils, specific features are highlighted, materials and construction details discussed and layout drawings included, accompanied by tabulated data on dimensions and weights. Among data contained is condensate rating information for both saturated and superheated steam. Installation recommendations and piping diagrams typical of various systems in which these coils are used are also presented.
American Radiator & Standard Sanitary Corporation, Industrial Div, Detroit 32, Mich.

Sealed Temperature Detector. Details of a resistance type temperature detector, sealed to prevent contamination, are given in Flyer E51-5. Extensive technical details are included, together with convenient quotation-ordering information.
Bailey Meter Company, 1050 Ivanhoe Rd., Cleveland 10, Ohio.

Controlled Condensing Temperatures. Closed Circuit Evaporative Water Cooling Systems are now cited as being able to control condensing temperatures within a narrow range, using either single or any multiple of compressor systems, regardless of fluctuating ambient wet or dry bulb temperature. In conjunction with this announcement, the manufacturer has published an evaporative water cooler multi-unit selection Work Sheet, 35E9c, which contains additional aids for use with information contained in Catalog 35C9c.
Recold Corporation, 7250 E. Slauson Ave., Los Angeles 22, Calif.

Pipe-Fitting Insulation. Fit-rite molded glass fiber pipe-fitting insulation is described in four-page Bulletin TD-105. Design features are presented, together with insulation specifications and dimensional data. Relative thickness of the material required for equal heat gain as compared to other media is shown for cold, low pressure and hot lines.
Fibrous Glass Products, Inc., a subsidiary of Pall Corporation, Alpa Plaza, Hicksville, N. Y.

Split-Body Catalog. Designated "Automatic Split-Body Control Valves and Accessories," this 20-page catalog presents data on the new "S" and "Y" style valves, each with its own angle variation. Included are detailed specifications, data and dimensions of various valve bodies with positioning piston, on-off piston, electro-hydraulic and manual actuators. Electric gear-driven actuators and pneumatic diaphragm actuators are discussed as optional methods. Determination of size, rating, end connections, valve action, materials, CV factor, effective area, max pressure drop, shipping weight, dimensions and catalog number may be made from information given in tabular form.
Hammel-Dahl Div, General Controls Company, Warwick Industrial Park, Warwick, R. I.

Explosion-Proof Refrigerators. Designed for operation in high ambient temperatures, with no sources of ignition on the interior, these refrigerators are UL listed for use in areas where the surrounding air contains any concentration of vapors or gases of any material except hydrogen,

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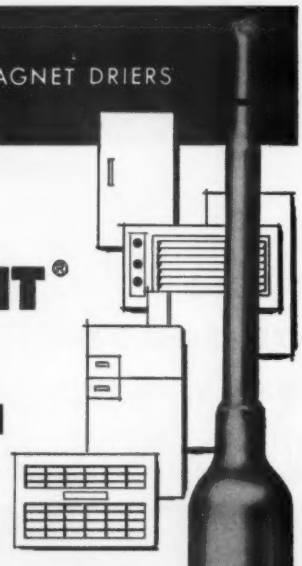

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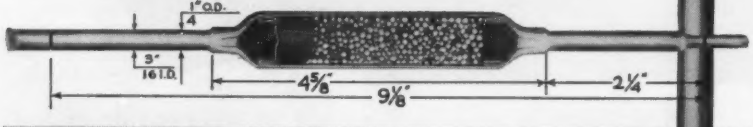

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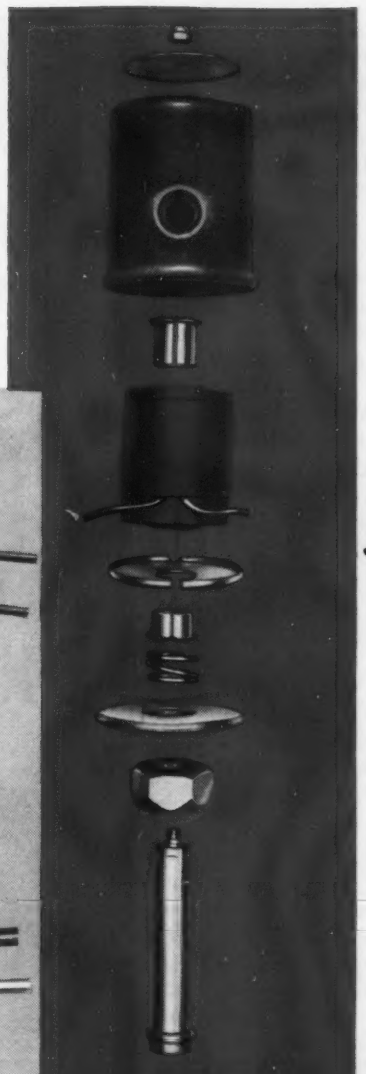

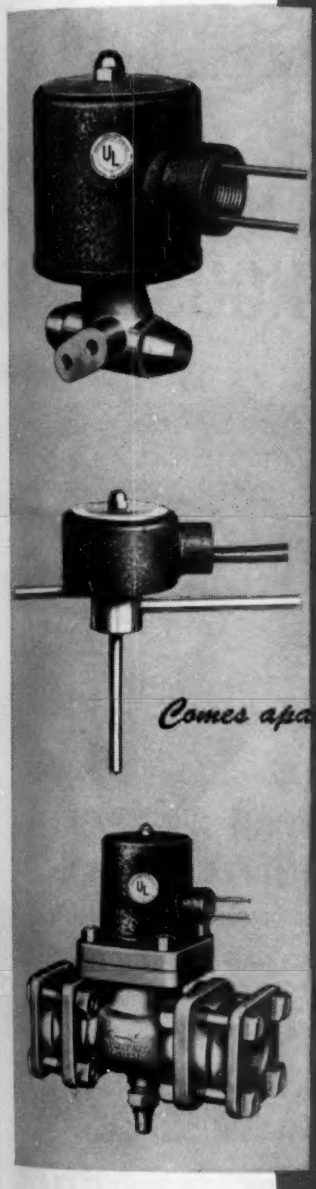

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DIVISION OF HAGAN CHEMICALS & CONTROLS, INC.

acetylene or manufactured gas. In a six-page folder are listed flammable or explosive materials commonly encountered which may be stored safely in these refrigerators.
Kelmore Service, Inc., 599 Springfield Ave., Newark 3, N. J.

Dirt and Dust Control. Statically bombarding dirt and dust particles and shattering them to a size below 0.1 micron, the Statronic System is the subject of four-page Bulletin S4-020. Illustrated is the method by which this system negatively ionizes the shattered particles to eliminate surface smudging, reducing maintenance costs.
CRS Industries Inc., 1405 Locust St., Philadelphia 2, Pa.

Silencer Products. Listing all types of silencer products for air conditioning, heating and ventilating equipment, eight-page Catalog 160 gives dimensional data, certified sound attenuation and pressure drop.
Elof Hansson, Inc., Acoustical Div, 711 Third Ave., New York 17, N. Y.

Outdoor Heating. Typical examples of outdoor areas heated with gas-fired infra-red heaters are shown in four-page Bulletin CS-306. Principles of infra-red heating are explained and available gas-fired equipment catalogued, together with a variety of applications. Four different units available are shown and heating capacities listed. Extensive specifications for the new Marque heater for application in exposed areas are also given.
Perfection Industries Div, Hupp Corporation, 1135 Ivanhoe Rd., Cleveland 10, Ohio.

Low and High Temperature Chamber. For testing components or subassemblies, this self-contained unit has two cu ft of test space, viewing and utility ports, and a temperature range of −100 to 240 F. Technical specifications are given in a flyer.
International Radiant Corporation, 577 E. 156th St., New York 55, N. Y.

Seven Day Time Switch. Detailed drawings in four-page Bulletin 72 show wiring plans for general applications in lighting, air conditioning and ventilating and for specific heating control applications. In the heating section are illustrated both low and line voltage systems and switching from high to low thermostat for night set-back. Time switches described feature dials revolving once in a week and permit the setting of one or several on-off schedules for

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complete
year 'round
controlability
when equipped with
New Marley originated
ADB PRECOOLER

that levels high dry bulb peaks and excessive pressures by adiabatically reducing incoming air temperature with no spray on coils. Permits economical selection of original equipment; adds capacity for increased or unanticipated condenser load. DriCooler-PreCooler combination efficiently converts water-cooled systems to air-cooled.

... and

DRICOOLER DAMPER CONTROL SYSTEM

the simplest, most efficient method of maintaining uniform pressure during low dry bulb periods. Automatically controls single or multi-circuit services. No added refrigerant charge; no oversized receiver.

Get the complete story on Series B DriCoolers; learn the added utility and economy of these air-cooled condensers.

MAIL COUPON TODAY

The Marley Company
Kansas City 14, Missouri
☐ *Send me complete information on DriCoolers with year 'round control.*
Mr._____
Company_____
Address_____

each day of the week as well as for skipping selected days. Units are available up to 55 amp.
Tork Time Controls, Inc., Mount Vernon, N. Y.

Air Conditioning Units. Revised Catalog 54C9c, for vertical and horizontal air conditioning units, contains general specifications, dimensions, arrangements and installation instructions for these two series, which are rated from 1200 to 34,800 cfm. Conditioners are offered in either Class I or II construction, the former featuring large, slow-speed blowers for quiet operating ranges and the latter being designed for high pressure systems and containing backward curved wheels, large shafts and bearings and heavy frames.
Recold Corporation, 7250 E. Slauson Ave., Los Angeles 22, Calif.

Sheet Metal Product Lines. In addition to illustrating and describing lines of flexible duct connectors, vane rail, blade kits, damper regulators and other specialties, this 20-page catalog includes several new products, such as a drill screw which forms its own hole in sheet metal, a ⅜-in. regulator set with a locking action cited as preventing damper rattle and a high-impact plastics air-flow regulator.
Duro-Dyne Corporation, Rte. 110, Farmingdale, N. Y.

Power Gas Conversion Burner. Explained in four-page Bulletin GC-571-M8 are mechanics, operation and installation of the unit, which features a self-lighting pilot. Described are the ignition system and wide input range (75,000 to 250,000 Btu/hr) with all gases.
Lennox Industries Inc., Marshalltown, Iowa.

Complete Line. Describing in brief the company's complete line of products, 24-page Bulletin B-5529 presents basic ratings for air conditioning and air handling equipment, fluid drives, heat exchangers, surface condensers, steel boilers and related industrial products.
American Radiator & Standard Sanitary Corporation, Industrial Div, Detroit 32, Mich.

Molded Packings. Opening eight-page Catalog MP-160 is a two-page section devoted to V-type packing, Palmetto Pyramid, followed by individual page descriptions of the Palmetto: U-ring, Kup and Pisto-ring. Applicable in many phases of industry, these packings are used on rods and pistons of hydraulic and pneumatic equipment, hydraulic presses, pumps, compressors and similar machines. Each type is illustrated and listed with comprehensive descriptions of its particular construction and specific use. General information includes style numbers, compositions, temperature ranges and services. Extensive tabular data on ODs, IDs, heights, wall thicknesses and groove lengths is given where applicable.
Greene, Tweed & Company, North Wales, Pa.

Temperature Controls. Simple and inherently stable temperature control packages, designated Simplytrols and applicable to a wide variety of industrial processes, are described in 12-page Bulletin 108. Explained in the bulletin are operation, circuitry and safety features of the three basic types of thermocouple-actuated controls offered, including a proportioning model cited as being capable of holding temperature to ± 1 F of set point.
Assembly Products, Inc., Chesterland, Ohio.

Centrifugal Exhausters. Centrifugal wheel in Series CK roof exhausters is non-overloading and made entirely of heavy-gauge aluminum. Air moving capacities for 141 models in the line are covered in four-page Bulletin 60-CK, which also includes dimensional and curb mounting drawings, electrical characteristics and optional accessories available.
Jenn-Air Products Company, Inc., 1102 Stadium Drive, Indianapolis 7, Indiana.

Underground Insulation. Subject of this Technical Bulletin is Insul-Fil, a mixture of coated perlite and a granular high softening point asphaltic resin. Perlite is cited as extending a greater insulation value than can be obtained with an unfilled asphalt and as arresting flow characteristics inherent in unfilled asphalt, preventing occurrence of voids under the piping. Featured in the bulletin are a series of drawings illustrating balanced systems, graphs for determination of heat loss that can be expected from various diam pipes in both wet and moist soils under different atmospheric and soil temperatures, and installation and thickness specifications.
Insul-Fil Company, a subsidiary of Miracle Adhesives Corporation, Bellmore, N. Y.

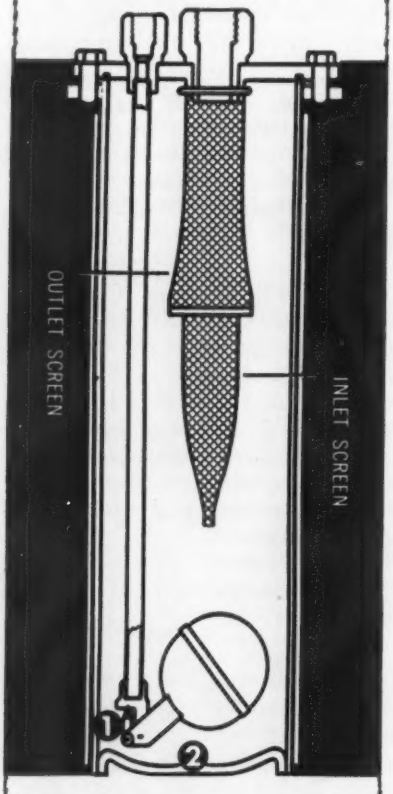
Close-Coupled Pump Motors. Four-page Bulletin MU-244 describes doubly-protected drip-proof and to-

(*Continued on page 86*)

BOOST
REFRIGERATING
EFFICIENCY
AND MUFFLE SOUND
with a
**TEMPRITE
OIL SEPARATOR**

Oil is separated from the gas before it can get into the evaporator and is returned to the compressor automatically . . .

- Full capacity of expansion valve assured.
- Evaporator heat transfer increased.
- Constant clean oil lengthens compressor life.
- TEMPRITE oil separator muffles sound.



1 OIL RETURN VALVE: Located ABOVE the sludge reservoir.

2 SLUDGE RESERVOIR: Traps sludge, oil carbon, and foreign substances, preventing their continued flow through the refrigerating system.

Complete range of capacities for refrigerants 12 and 22. ASME and UL approved.

8 PAGE BOOKLET ON REQUEST
Describes many advantages of Temprite Oil Separators.

Temprite Products Corporation
P. O. Box 72 • E. Maple Rd.
Birmingham, Mich.
Send me Oil Separator Booklet No. T-397

Name_____
Address_____
City_____ Zone____ State____

Others are saying

(*Continued from page* 61)

formance of an absorption refrigerator cannot exceed unity; an ammonia compressor operates most efficiently when taking in wet vapor; because air is lighter than compressed ammonia vapor it will therefore collect at the top of a condenser; and the identification of the index for isentropic compression of a vapor with the ratio of its specific heats. *Journal of Refrigeration, January/February 1960, p 1 (British).*

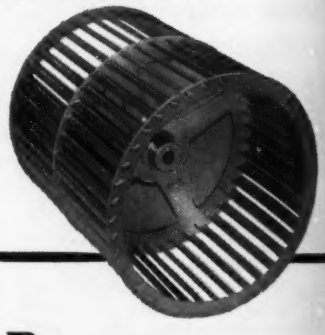
that . . . . to have controlled weather, it would be necessary in many areas to heat or cool, humidify or dehumidify the air adjacent to the ground, and to produce rains to prevent droughts. Cost of providing controlled weather by artificial means must necessarily be high. In this article the author presents an engineering analysis to estimate the power that must be supplied by nature in order to produce a copious rain. *Kentucky Engineer, March 1960, p 38.*

that . . . . . as manufacturers of cooling coils in England do not publish tables of ratings from which an air conditioning engineer can select the coil best suited to his requirements, the designer must send an inquiry to the manufacturer stating the performance required at max load and giving the coolant conditions. This article attempts to provide sufficient information on general performance of finned pipe cooling coils to meet the needs of engineers in framing such inquiries in the most economical terms. *Journal of the Institute of Heating and Ventilating Engineers, February 1960, p 313 (British).*

that . . . . advantages of hot water storage as a method of recovering waste heat from industrial processes include: reduced steam peaks, increased production due to availability of hot water and some fuel savings on boiler plant due to operation on a steadier load. Waste heat recovery from vapor and process effluents is considered in detail in this article. *Heating, April 1960, p 124 (British).*

WHY?
Why Does
Amana
REFRIGERATION, INC.
use **Revcor**
"BLASTAIRE"
BLOWER WHEELS?

because...

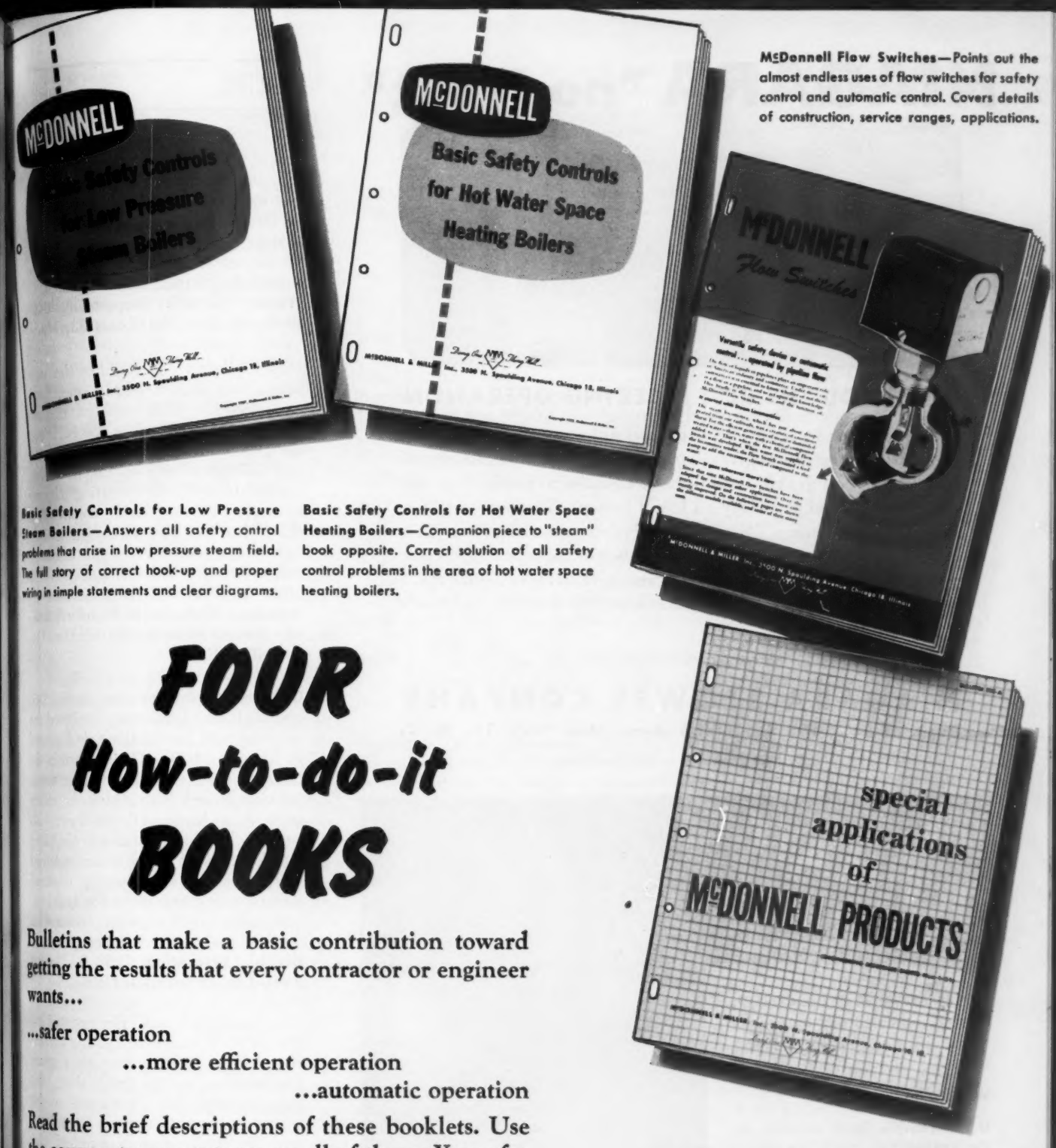


***Revcor** Double Inlet*
Blastaire Blower Wheels use less space and meet the high performance and quality standards demanded by Amana!

***Revcor** Single* and *Double* INLET BLASTAIRE BLOWER WHEELS ARE USED BY OVER 60% OF THE ROOM AIR CONDITIONER MANUFACTURERS!

WRITE FOR FREE BROCHURE
or send specifications to:

Revcor INC.
ENGINEERS-MANUFACTURERS
247 Edwards Street
Carpentersville, Ill.



McDonnell Flow Switches—Points out the almost endless uses of flow switches for safety control and automatic control. Covers details of construction, service ranges, applications.

Basic Safety Controls for Low Pressure Steam Boilers—Answers all safety control problems that arise in low pressure steam field. The full story of correct hook-up and proper wiring in simple statements and clear diagrams.

Basic Safety Controls for Hot Water Space Heating Boilers—Companion piece to "steam" book opposite. Correct solution of all safety control problems in the area of hot water space heating boilers.

FOUR How-to-do-it BOOKS

Bulletins that make a basic contribution toward getting the results that every contractor or engineer wants...

...safer operation

...more efficient operation

...automatic operation

Read the brief descriptions of these booklets. Use the coupon to request any or all of them. Yours for the asking.

Special Applications of McDonnell Products—Twenty-one case studies of simple control problems that can turn up almost anywhere. Each case suggests others. Liquid level and flow control problems are clearly defined and met.

McDONNELL & MILLER, *Inc.*
3500 N. Spaulding Ave., Chicago 18, Ill.

Doing One Thing Well

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BOILER WATER FEEDERS • LOW WATER FUEL CUT-OFFS • PUMP CONTROLLERS • RELIEF VALVES • FLOW SWITCHES • RELATED LIQUID LEVEL CONTROLS FOR TANKS, STILLS, AIR CONDITIONING SYSTEMS

Your Jobber Stocks McDONNELL Products

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Send bulletin (or bulletins) checked:

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NIAGARA "no frost"

GIVES YOU THE BEST FREEZING OPERATION

● Saving labor in both operation and upkeep, "No-Frost" fully automatic refrigeration gives you always the full rated capacity of your plant. You get all the benefits of continuous production and your business makes money on lower volume. Preventing all ice or frost accumulation, "No-Frost" prevents waste of power. You cut out much expensive maintenance labor in the cold room. Your production and your quality both improve because "No-Frost" pulls the product core temperature down the quickest and holds it uniformly.

Write for Bulletin No. 105

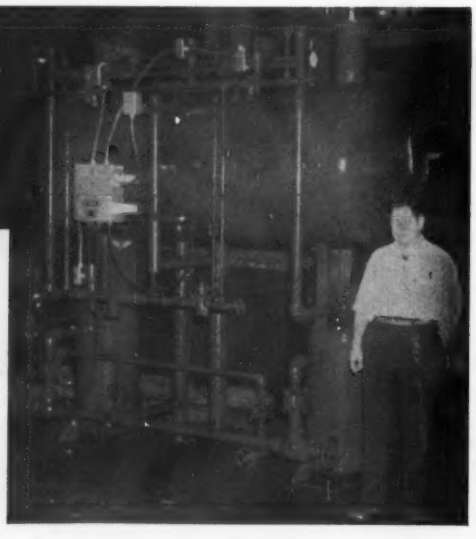
NIAGARA BLOWER COMPANY

Dept. RE-6 405 Lexington Ave., New York 17, N. Y.

District Engineers in Principal Cities

THE ULTIMATE

IN THE COMPRESSION REFRIGERATION CYCLE*



THIS IS ANOTHER CYCLE CENTER, factory assembled and on its way to a 150 ton poultry freezing plant.

What will it do?*

It will provide liquid overfeed to the evaporators, catch the excess liquid and recirculate it to the evaporators, with these results:

- FULL COMPRESSOR PROTECTION AGAINST SLUGS
- PEAK COIL AND COMPRESSOR EFFICIENCIES
- SUB COOLED LIQUID FEED AT CONSTANT PRESSURE THE YEAR AROUND
- PRACTICALLY UNLIMITED RATE OF LIQUID FEED AT ABSOLUTELY NO POWER COST
- NO MECHANICAL PUMPS
- NO FLASH GAS IN LIQUID LINES
- SAFE, AUTOMATIC PLANT OPERATION
- OIL SEPARATION, ANY REFRIGERANT
- HIGHER SUCTION PRESSURES
- LARGE POWER SAVINGS
- LARGE SAVINGS IN FIRST COST ON NEW PLANTS. FOR EXAMPLE, THE RECEIVER IS NOT REQUIRED AND SURGE DRUMS ARE ELIMINATED.
- AUTOMATIC HOT GAS DEFROSTING AT MINIMUM COST

ASK FOR BULLETIN CC-2

*** NOT JUST A LIQUID RETURN UNIT.** Available for any refrigerant, in capacities from 10 to 1,000 tons and more. Factory assembly is optional.

J. E. Watkins Co.

307 LAKE STREET, MAYWOOD, ILLINOIS

BULLETINS

(*Continued from page* 83)

tally enclosed polyphase squirrel-cage motors, one hp and larger, with Nema C faceplates for close-coupled centrifugal pump applications. Covered by use of cutaway illustrations, are electrical and mechanical features. **Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis 33, Mo.**

Dust Collector. Describing the new Series 345 dust collector line, four-page Bulletin 1928 outlines the advantages of large tubes for high efficiencies and resistance to plugging and utilizes a cutaway section illustration to explain operating characteristics. Design and construction principles are also discussed. Highlight of the bulletin is a pair of nomograms, one for collector selection, the other for efficiency determination. **American Radiator & Standard Sanitary Corporation, Industrial Div, Detroit 32, Mich.**

Condensers. Introduction of the Dricon Upblast Condenser, designed for outdoor roof applications, is featured in Catalog 34C9a. Condensers in the Dricon series are available in nominal sizes from five to 40 ton, for either vertical or horizontal air flow, with rugged housing, balanced circuiting and large, slow speed fans. Contained in this booklet is a detailed explanation of sizing the units for multi-circuit jobs, together with information on their use as jacket water coolers. **Recold Corporation, 7250 E. Slauson Ave., Los Angeles 22, Calif.**

Size Selection Chart. For determining the sq ft of Panelcoil heating surface required to heat water to a given temperature in a given time, the manufacturer has developed a size selection chart, Technical Data Sheet No. 78. Only factors required are gal to be heated, to what operating temperature, in what min time, "U" heat transfer value and operating steam pressure. **Dean Products Inc., 1048 Dean St., Brooklyn 38, N. Y.**

Electrical Flow Meters. Remote reading electrical flow meters for all types of liquids and gases at line pressures to 5000 psi are the subject of 28-page Bulletin 59.5. An extensive line of meters is illustrated, principles and engineering features are described, and included are typical electrical circuits, flow charts, piping and boiler arrangements and piping requirements

for orifices, flow nozzles and venturi tubes.
Republic Flow Meters Company, subsidiary of Rockwell Manufacturing Company, 2240 Diversey Pkwy., Chicago 47, Ill.

Cold Treatment. Designed for testing components on a production basis to assure maintenance of tensile, impact and resistance strength at high operating temperatures; control of brittleness; fatigue resistance and electrical conductivity, these temperature and humidity chambers are the subject of four-page Bulletin 102 3 159 OP. Product is illustrated, specifications are given and units are extensively described.
Harris Refrigeration Company, 308 River St., Cambridge 39, Mass.

Eccentric Valves. Eight-page Bulletin 110 lists features of these valves, as well as materials, pressure ratings, dimensions and accessories, and outlines applications of the units.
DeZurik Corporation, Sartell, Minn.

Ventilated Skylights. Full details and specifications on Astro-Lites and Astro-Vents are contained in eight-page Bulletin 60-LV, which includes installation drawings, dimensions, dome and electrical specifications and details on curbs for the units. Astro-Lites feature a one-piece acrylic resin dome and are offered in square or rectangular shapes ranging in length from 14 to 115 in. Astro-Vents are suitable for heavy-duty commercial, institutional and industrial requirements and are available with air moving capacities up to 4400 cfm.
Jenn-Air Products Company, Inc., 1102 Stadium Drive, Indianapolis 7, Indiana.

Air Filter. Four-page Bulletin B tells how Ulok Cube Type Replacement Air Filters are capable of reducing filter bank face area by more than 50%. Reverse loading, cited as being responsible for high efficiency and long life of the filter unit, is described in detail. Exploded-view illustrations show how the four components are assembled prior to installation in a filter bank. A diagram illustrates typical arrangements and a data table lists the capacity and resistance of each of the dozen filter sizes.
Union Carbide Development Company, 30 E. 42nd St., New York 17, New York.

Gas Burners. Junior Fan-Air Gas Burners, with new capacities from 100,000 to 3,600,000 Btu/hr, are described in four-page Bulletin G-100-B. Cutaway photo aids description of combustion design of multiple gas jets, which atomize fuel with unrestricted air supply for thorough ignition on mechanical or limited natural draft operations. Bulletin also includes dimensions, applications, and min and max capacities of burners for furnaces, boilers, incinerators and process equipment.
Mettler Company, Inc., Div of Eclipse Fuel Engineering Company, Rockford, Ill.

Industrial Air Conditioning. How to determine whether factory air conditioning will be a profitable investment is the subject of a 16-page bulletin. Presented are four key check-figures with which plant executives can qualify their operation.
Carrier Corporation, Syracuse, N. Y.

Silicones. Silicone products reviewed in 16-page Bulletin 1-115 range from adhesives to release agents, laminating resins to rubber compounds and electrical insulation to water repellents. Table of contents is arranged according to applications, enabling easy reference to silicone materials that resist the effects of time, heat, moisture, weathering, oxidation and chemical attack. Bulletin is extensively illustrated with photographs, tables and graphs.
Dow Corning Corporation, Midland, Mich.

Cast Brass Fittings and Valves. More than 5000 items in this manufacturer's extensive line are illustrated and described in 60-page Catalog 60. Engineering data with pictorial cross sections of valves and fittings, together with their dimensions, are also included.
Lee Brothers Foundry Company, Inc., Box 231, Anniston, Ala.

Panelcoil. Illustrations in Flyer M10 show types of Panelcoil variations in design that are available to suit individual requirements for heating or cooling both flat and curved surfaces. Eleven applications are cited.
Dean Products, Inc., 616 Franklin Ave., Brooklyn 38, N. Y.

General Purpose Valves. Introducing an extensive new line of valves for industry, 40-page Catalog 160 presents a wide range of other products, including flare fittings, shut-off valves, drain cocks, tube working tools and brass pipe fittings.
Madden Brass Products Company, Aurora, Ill.

Glass Fiber Insulation. Easy to handle and readily cut to size with knife or scissors, Microlite, a lightweight, blanket-type glass fiber insulation for heating or air conditioning ducts or combination heating-cooling ducts, is the subject of six-page Bulletin IN-285A. Standard application methods are illustrated and moisture barrier materials available already attached to the product are listed. Thickness range available is from one to two in., widths 24, 36 and 48 in. and densities from 0.06 to three lb/cu ft.
Johns-Manville, 22 E. 40th St., New York 16, N. Y.

CHAPTER AND REGION NEWS

(*Continued from page 67*)

elected Floyd R. Denham of Carnahan and Thompson to membership of the Nominating Committee, with Clarence L. Fleming of Fleming Refining Company as Alternate. H. I. Hoffman, speaker at the dinner meeting, addressed members and guests on "Evaluation of Heat Transfer and Moisture Migration Problems."

At the Region IX meeting on May 4th, held in Salt Lake City with Regional Director Fred Janssen in charge, members and guests were conducted on a tour of the air conditioning installation at Mountain Fuel and heard ASHRAE 2nd Vice President R. H. Tull speak on the United Engineering Center Building Fund. Jack K. James and C. E. Ferguson were elected to the Nominating Committee as Member and Alternate, respectively.

Coupled with the Region X meeting, held May 6-7 in Fresno with Charles L. Hall in charge, was a Regional Conference. Speeches at the Technical Session included discussion of the Society's research program by past-President Arthur J. Hess; "Outdoor Design Temperatures," covered by William L. Holladay, ASHRAE Fellow; and a talk on air distribution by Robert R. Lambert, President of Air Factors, Inc. Elected to the Nominating Committee were Charles L. Hall of Refrigeration Engineering Company as Member and Ralph M. Westcott of Holladay Westcott as Alternate.

Applications

CENTRAL SYSTEM SELECTED FOR THIRTY-STORY BUILDING

With 2000 rooms and occupying a city block, the new 30-story Imperial House, under construction in New York City, will be air conditioned by a central system with fan-coil units. With no interior spaces requiring year round cooling, the building was not provided with standby service; a single 940-ton Trane hermetic CenTraVac centrifugal compressor was selected for the system. To keep the compressor from shutting down frequently at light loads, cooling tower fans are cycled under control of a condenser water thermostat to maintain a high water temperature. To insure max quietness, Trane fan coil units were selected to provide the required capacity for average conditions when operating on the intermediate speed of three-speed motors. Manual switches will permit tenants to select the speed for their own comfort.

Cooling capacity of these units operating at top speed for living rooms is 11,500 Btu/hr at 400 cfm; bedroom units have a cooling capacity of 8300 Btu/hr at 300 cfm. An outdoor air inlet is provided through the wall at each unit with a manual damper. Bathrooms are on the interior, ventilated through an exhaust duct system with roof fans and heated with 750-watt electric heaters to be used as desired. Kitchens, which are on outside walls, have steam convectors on a separate steam system with no provision for cooling. Four steam boilers supply heating, each with a rated capacity of 45,000 sq ft EDR.

Heating system is divided into two zones, north and south, with a hot water converter supplied for each zone. Water temperature during the heating cycle is controlled by two valves in parallel to each converter, operated in sequence from an outside thermostat and the water temperature. The lobby has its own 20-ton package cooling unit.

OUTSIDE LOUVERS AID CONTROL OF RADIANT SOLAR HEAT

Large areas of glass on both the south and east walls of the Fidelity Savings and Loan Association building in Glendale, Calif., caused a problem in extreme temperatures at the windows resulting from radiant solar heat. In order to control this, automatically operated sun louvers, produced by Lemlar Manufacturing Company, were installed on all first and second floor windows.

Louvers are controlled by timers pre-set according to sun motion data and run by a 1/3-hp electric motor. As the sun strikes the building at changing

(*Continued on page* 99)

GET ACCURATE FLOODED SYSTEMS CONTROL

with this level regulator

A SIMPLE CONTROL IS THE BEST CONTROL

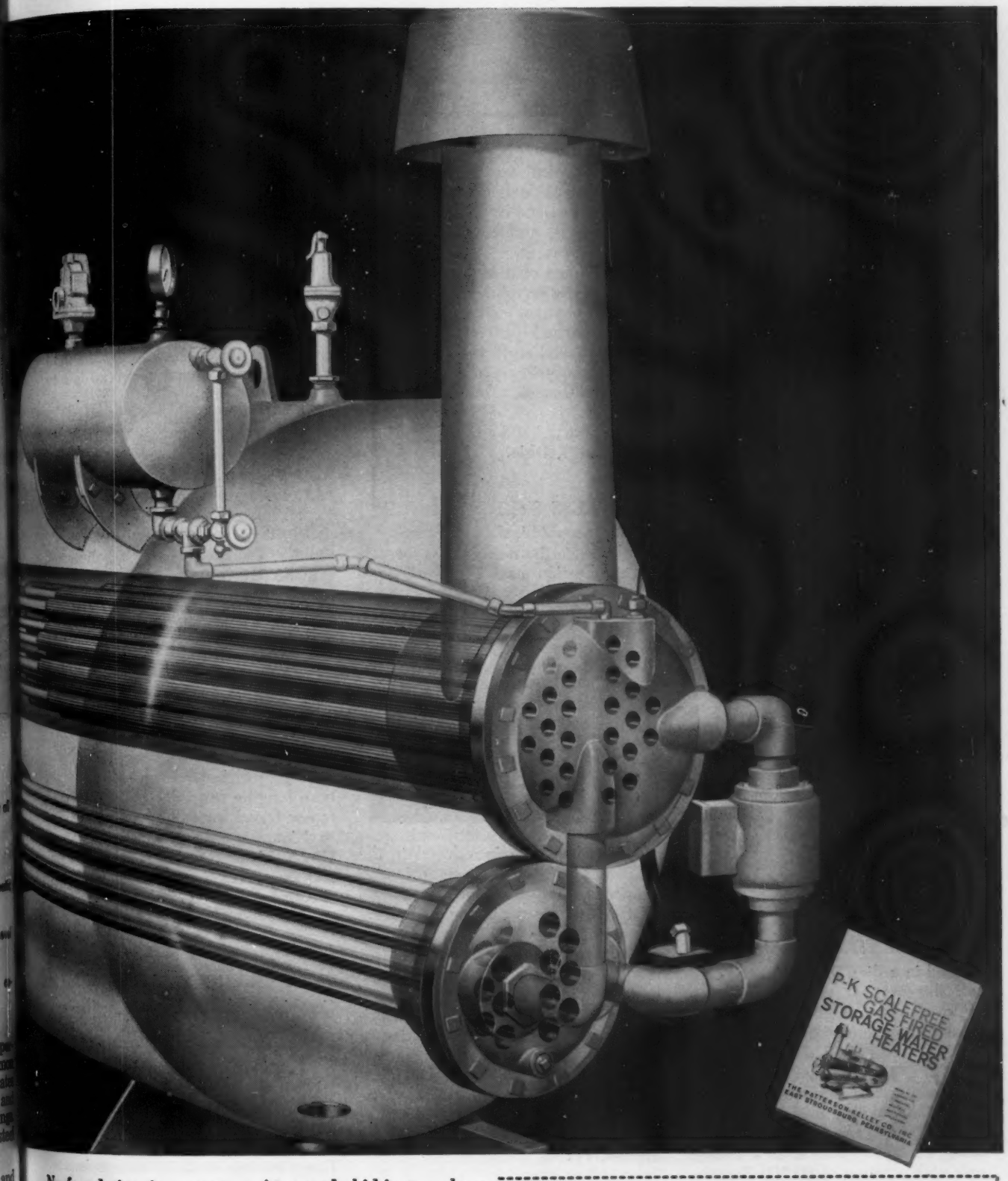
PHILLIPS
FLOAT CONTROLS

- **Proportioning action for smooth feed at all capacities**
- **Tight Closing with Teflon seat discs**
- **Self actuation—no electrical or pneumatic connections needed**
- **Visible liquid level through exclusive "Level Eyes"**
- **Adjustable level achieves maximum capacity with minimum charge**

IN ADDITION — Phillips pilot operated valves are available for all common refrigerants, down to —50° F. Operate with as low as 2 PSI pressure drop and up to 250 PSI with selected springs. Line sizes ½ inch to 4 inches with steel or copper connections.

Solve your flooded system design and application jobs by consulting Phillips. Our firm of engineers have specialized in level control, liquid-vapor separation, liquid circulation and return systems for over 28 years.

H. A. PHILLIPS & CO.
Designers and Engineers
Refrigeration Control Systems
3255 W. Carroll Ave.
Chicago 24, Illinois



No foundation is necessary. A rugged skid-in type base is supplied. It is easily accessible for inspection. Tube bundles are removable.

SCALEFREE 230 is completely safe. It has a fail-safe chain of built-in protective devices. It is available in more than 100 storage and recovery combinations. Storage capacities range from 250 to 4000 gallons. Recovery sections range from 390,000 to 2,215,000 Btu. Send the coupon for complete information.

*Patent pending

Patterson Kelley

111 Morgan Ave., East Stroudsburg, Pa.

☐ Please send complete technical data on SCALEFREE 230

☐ Please have a P-K Sales Engineer call to discuss design and operational features.

Name_____ Position_____

Company_____

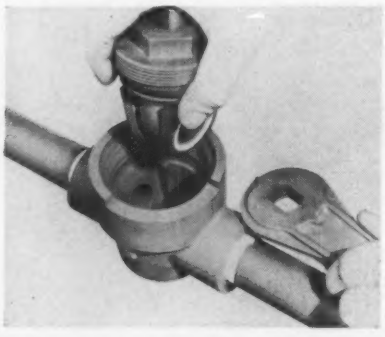
Address_____

City_____ Zone_____ State_____

PARTS and PRODUCTS

THERMOPLASTICS VALVES

Formed by the injection molding process, these top-entry, top-adjusting ball valves are made of unplasticized polyvinyl chloride for operating temperatures to 150 F and of Penton



(chlorinated polyether) for hot corrosive service to 250 F and higher. They are available in ½ through 3-in. nominal pipe sizes, threaded or socket type.

Top-entry feature of the valve makes possible on-the-line maintenance, as shown. Easy access to working parts without disconnecting any piping is achieved by unscrewing the valve bonnet and lifting out the ball-and-stem and seating inserts. An adjusting nut on the valve bonnet enables adjustment of ball seating force from the top.

Tube Turns Plastics, Inc., Louisville 11, Ky.

YEAR-ROUND SYSTEMS

Housed in a slim, fully insulated cabinet, this vertical year-round system cools, warms and filters air. It will be offered in three different sizes with heating ratings of 75,000, 100,000 and 125,000 Btu to meet the needs of both commercial and residential applications. The cooling evaporator coil is available in a three-ton unit with a rating of 36,000 Btu or in a five-ton unit with a rating of 60,000 Btu.

Bar-Brook Manufacturing Company, Inc., 6135 Linwood Avenue, Shreveport, La.

HEAT RESISTANT PAINT

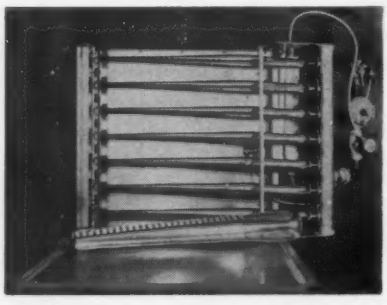
Available in 18 high heat resisting colors, Heat-Rem H-170 coatings, depending on the shade used, are cited as permitting color coding or complete finishing of metal components subjected to temperatures from 600 to 1700 F. Typical applications include heat transmission lines, traps, stacks, vents, condensers, compressors, ovens, engine heads, mufflers, radiators and pressure furnaces.

Most colors contain a combination of non-leafing aluminum and a special metallic pigment, cited as making possible virtual fusion of the paint with hot metal surfaces. In addition, the finish is resistant to moisture, corrosion, mild acids, alkalies and industrial fumes.

Speco, Inc., 7308 Associate Ave., Cleveland 9, Ohio.

STAINLESS STEEL BURNER

Burner assembly shown, utilizing a stainless steel burner cited as increasing combustion efficiency of all types



of gases, has been introduced in the DS series of gas-fired duct furnaces. Burner is a universal unit for use with all types of gases ranging in heating values from 500 to 3200 Btu/cu ft and features formed port burners with integral carryover. Straight line shape of the unit, which offers min turbulence or restrictions, gives a high primary aeration coefficient, resulting in increased burning efficiency. Narrow port sections and high external port depth are additional features of the burner.

Reznor Manufacturing Company, Mercer, Pa.

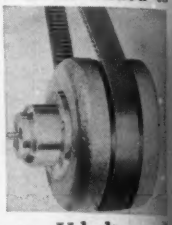
EXPANDED LINE

Newest in the CR heating-cooling unit line is the CRVR model, with finished front for total recess and spacers for semi-recessed mounting. Four sizes are available: 220 volt, 1/30 hp, 16⅞ x 10-in. filter; 330 volt, 1/30 hp, 16⅞ x 10-in. filter; 450 volt, 1/20 hp, 22⅞ x 10-in. filter; and 600 volt, 1/15 hp, 33⅞ x 10-in filter. Motor speeds are 800, 950 and 1050 rpm. Cooling capacity with water coils in Btu/hr is: for 220 volt, 5600 (total heat) and 3900 (sensible heat); for 330, 8400 and 6600; for 450, 13,200 and 9000; and for 600, 21,000 and 13,500. Heating capacities in Btu/hr are 16,500, 25,400, 35,300 and 55,000. Direct expansion coils in various cooling and heating capacities are also available.

Dunham-Bush Inc., West Hartford, Conn.

VARIABLE SPEED PULLEYS

Five variable speed pulleys, including adjustable motor bases, V-belts and V-belt sheaves, have been added to this line of cam-operated pulleys. Rated for 1, 1½, 2, 3 and 5-hp motors at 1750 rpm and for ¾ to 3¼-hp motors at 1150 rpm, the



pulleys utilize narrow V-belts and provide speed ratios of three to one.

Use of narrow V-belts, from ⅞ to 1-7/16-in. top widths, is cited as helping to lessen operating costs on drives of this range. They can be installed easily on new or old equipment to provide instantaneous speed changes with slight pressure while the machine is running. Depending upon pulley model, standard bore sizes are ⅝, ¾, ⅞, 1 and 1⅛ in. with bore lengths from 2½ to 3⅝ in. and motor travel for full speed range 3¼ to 4 in.

Hi-Lo Manufacturing Company, an affiliate of Lovejoy Flexible Coupling Company, 4949 W. Lake St., Chicago 44, Ill.

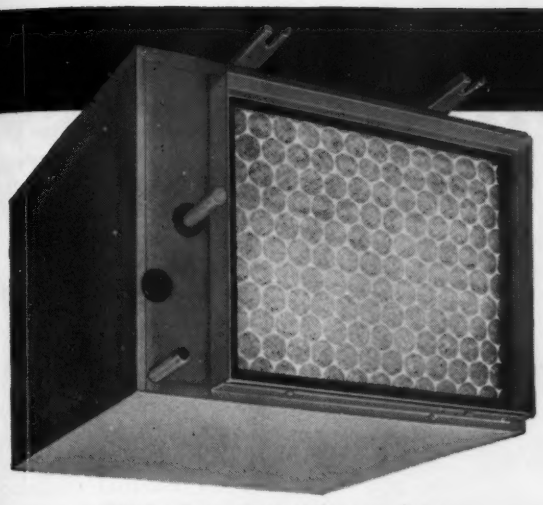
COOLER-FREEZER

Combining three separate units into one cabinet is an expandable reach-in, walk-in cooler-freezer, Model 118-S-F1C3. Its front compartment, refrigerated to 35 F, is a conventional reach-in, walk-in refrigerator which may be entered through a flush walk-in door and three reach-in doors. Large volume walk-in storage is provided for bulk goods, while smaller items may be stored on aluminum shelves convenient to the reach-in doors.

Elliott-Williams Company, Inc., 3737 Sutherland Ave., Indianapolis 18, Ind.

ROOF INSULATION

Dense, fine-fiber, plastics-bonded board with high resistance to puncture, crushing and damage from foot



DAH for new systems in attic or crawl space

FP for furnace plenum

DAC for duct installation in hot air systems

COMPACT—EASY TO SELL AND INSTALL

LARKIN AIR CONDITIONING COMPONENTS

2, 3, 4 and 5-ton Capacities †

It's time to turn the sizzling home air-conditioning market into a piece of cool profit for yourself. One way to make that profit, and hold on to it, is to build custom systems with dependable LARKIN Air Conditioning Components.

Whether converting existing hot air systems, adding cooling to homes with wet heat, or installing year-round systems in new homes—it will pay you to use quality LARKIN products, priced to give you a competition advantage.

A HOST OF STRONG FEATURES

- Available in 2, 3, 4 and 5-ton capacities†
- Equipped with Larkin cross-fin coil, staggered copper tubing with aluminum fins UL approved
- Evaporator equipped with pressure-type distributor and external equalizer connection
- Insulated drain pan to prevent sweating
- Pre-punched holes for easy installation
- Cases of the DAH and DAC are fully insulated and finished in gray enamel
- The DAH is equipped with centrifugal fan, permanently lubricated motor and throw-away filters

BASIC RATINGS

Model	Capacity Btu/hr*	Cfm	Model	Capacity Btu/hr*	Cfm	Model	Capacity Btu/hr*	Cfm 0" SP
FP-2	25,600	800	DAC-2	25,100	800	DAH-2	24,800	950
FP-3	35,900	1200	DAC-3	37,300	1200	DAH-3	39,400	1375
FP-4	48,100	1600	DAC-4	48,960	1600	DAH-5	64,800	2180
FP-5	61,300	2000	DAC-5	61,200	2000			

†DAH is not available in 4-ton size

**Capacity based on 80° DB 67° WB entering air, 40°F suction temperature, R-12 or R-22 refrigerant.*

WATCHDOG OF THE NATION'S FOOD AND COMFORT — LARKIN

SEE YOUR WHOLESALER

OR WRITE FOR BULLETIN 1054-B

LARKIN COILS INC.

519 Memorial Drive, S.E. • P. O. Box 1699 • MUrray 8-3171

ATLANTA 1, GEORGIA

traffic has been introduced for use in insulating flat, built-up roofs. Use of Aloyglas fibers is cited as creating an increased number of dead air cells for max insulating value. Heavy asphalt-kraft vapor barrier facing is carried over the long edge of the board and several in. under the 2 x 4-ft panel to facilitate handling and minimize damage during application.
Forty-Eight Insulations, Inc., Aurora, Illinois.

CENTRIFUGAL FANS

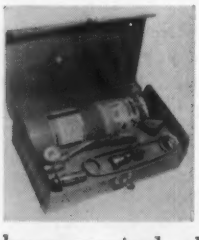
Self-contained, belt-driven centrifugal fans feature motor and fan bearings mounted on rubber isolation rails, minimizing vibration and resonant noise.

Util-A-Set ventilators are designed for applications requiring low and medium ranges of volume and pressure. Backward blade or forward curve wheels are available to meet most application requirements. Twelve sizes

provide a capacity range from 688 to 23,000 cfm. Optional features include: weather cover for motor and drive, housing access door and drain plug.
Ilg Electric Ventilating Company, 2850 N. Pulaski Rd., Chicago 41, Ill.

TORCHES AND KITS

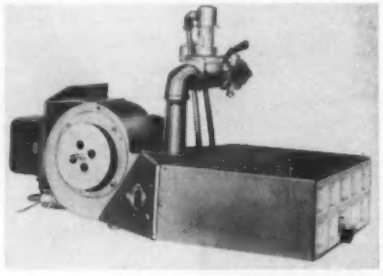
Propane-fueled utility torches and torch kits, designated Bernz-O-Matic, may be used for soft soldering, copper tube sweating and general applications requiring heat. Advantages cited include: instant starting, long burning, self-sealing valves, no hoses required, all position burning and disposable cylinders. Equipment is available in single cylinders with push-button to pencil-type tip assemblies, or in carry-all kits which include many of the accessories needed for most applications.



Air Reduction Sales Company Div, Air Reduction Company, Inc., 150 E. 42nd St., New York 17, N. Y.

GAS BURNERS

New input capacities, from 100,000 to 3,500,000 Btu/hr, have been



announced for Junior Fan Air gas burners. Operating with air from a low-speed fan, these burners feature removable gas jets which atomize unrestricted air and metered fuel supply in each of four burner ports. A spark-ignited safety pilot and electronic flame safety relay protect against flame failure.
Mettler Company, Inc., Div of Eclipse Fuel Engineering Company, Rockford, Ill.

INDOOR TOWERS

Three new models have been added to the AquaCooler line, extending the number of units to 14, with a nominal top capacity of 90 ton. Claimed for these indoor cooling towers are increased installation adaptability due to interchangeability of casing panels, selectability of air intake and air discharge direction and multiple choice of hot water inlet and suction connection locations.

All models feature quietly operating centrifugal blower fans, balanced spray nozzle water distribution system and close-packed filling for max air-water contact. Casings, basins, fans and fan scrolls are hot dip galvanized after fabrication.
Marley Company, 222 W. Gregory Blvd., Kansas City 14, Mo.

WINTER CONTROLS

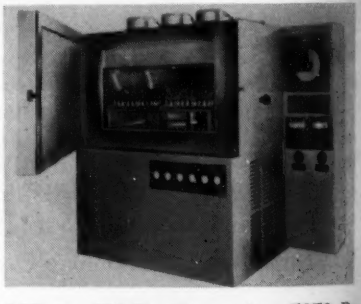
Basically consisting of two valves, an adjustable control valve and a balancing valve, Wintermatic control system, available for use with Dri-Con air cooled condensers, is designed to regulate system head pressures during low ambient periods. Acting as a pilot for the system, the adjustable control may be adjusted to maintain the min desired head pressure. As the pressure drops below this min, the balancing valve opens and gas will by-pass the air-cooled condenser, still maintaining the higher head pressure necessary to keep the compressor operating. For extremely large capacities, two or more systems may be used in parallel on one condenser.
Recold Corporation, 7250 E. Slauson Ave., Los Angeles 22, Calif.

CLEANER-DEBURRER

For cleaning and deburring all size tubing up to four in., the Toled-O-Matic No. 1 Buff-Ezy is portable and precision built. A four-in. main brush with adjustable "reverse L" guide handles all external cleaning operations. For internal cleaning and deburring, three sizes of brushes and a rotary internal deburring tool work off the other end of the motor shaft under a clear plastics protective guard. The machine is equipped with a 1/3-hp single-phase motor operating on 115 volt, 60 cycle ac.
Toledo Pipe Threading Machine Company, Toledo, Ohio.

ENVIRONMENTAL CHAMBER

Designated Model WF–12–125+400, this chamber for research and development of certain semiconductor materials and similar applications has an adjustable temperature range from

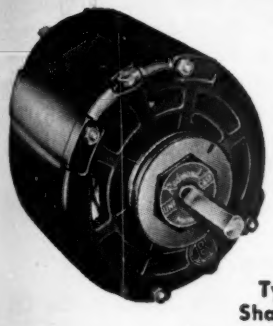


–125 to 400 F. Removing 7270 Btu from the product load in 15 min, the mechanical refrigeration system features a cascade condenser. Stainless steel interior is pressure tight and has controlled nitrogen flow. Dimensions are 44 x 24 x 19 in. and capacity 12 cu ft. Instrumentation is programmed, visible, indicating, adjustable and recording. A four-point selector switch indicates temperature of product load for three additional temperature zones. In addition, two electronic, visible, indicating safeguards monitor high and low temperature settings.
Webber Manufacturing Company, P. O. Box 217, Indianapolis 6, Ind.

SUBMERSIBLE PUMP

Built in 16 sizes from five to 40 hp, Series UF Turbine Bowl submersible

Redmond Brings You NEW { MOTORS MARKETS PROFITS



For Room Air Conditioners ⅓ to 2 Horsepower

Type AY Shaded Pole or Type CY Permanent Split Capacitor

Air Conditioning Replacement Motors

This permanent split capacitor motor combines high starting torque with low current requirements. Totally enclosed to eliminate moisture problems. Designed for easiest installation—resilient mounting base available where 3-inch shaft height required, and double-shaft extensions are long enough to cover all applications. "Quick Disconnects" let you put in motor and then plug in leads. Only one motor needed for both two-speed replacements and single-speed units.

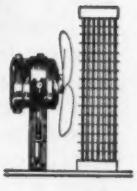
The Type AY MicroMotor is your guarantee of customer satisfaction.

Quietest Direct Drive Blower Motors

New design reduces blower vibration to one-fifth that of units using conventional shaded-pole motors

This motor gives you satisfied customers—when you replace direct drive blower motors with it you solve the problem of vibration noise. Designed and manufactured in every way to give years of whisper-quiet, trouble-free service.

Your No. 1 Condenser Fan Motor for Replacement in the Air Conditioning and Refrigeration Field.



Condenser Fan Motor 1½ through 16 Watts

Condenser Fan Replacement Motor

Shorter length makes AM-4 completely interchangeable • Stock one motor to accommodate all mountings

The Am-4 replaces all rear-mounting motors and motors with peripheral mountings. Designed for all-angle operation and all-position mounting. Extra large oil reservoir permanently sealed for life-time lubrication—guaranteed not to leak oil in use or shipment.

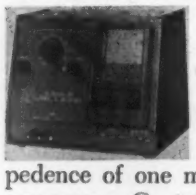
Redmond DISTRIBUTORS DIVISION REDMOND COMPANY, INC., OWOSSO, MICHIGAN

See the Yellow Pages of Your Telephone Directory for Your Local Redmond Distributor

pumps will provide capacities up to 180 gpm from well depths to 1450 ft. Bowl assemblies, varying in number from two to 23 depending on well depth, feature heavy cast iron bowls with corrosion resistant baked-on alkyd melamine finish, bronze impellers and stainless steel fastenings. Tandem bearings located in each stage are leaded bronze and cut-less rubber. Motors are water lubricated, prefilled, requiring no external lubrication and with motor leads protected by a heavy gauge stainless steel guard.
Goulds Pumps, Inc., 208 Black Brook Rd., Seneca Falls, N. Y.

LABORATORY RECORDER

Operating as a zero left, zero center or zero right recorder, Model 80 has five full scale calibrated voltage ranges (10 and 100 millivolt; 1, 10 and 100 volt) and five current ranges (1, 10 and 100 microamp; 1 and 10 milliamp). It can be operated grounded or floating up to ± 200 volt from ground and has an input impedence of one megohm on all voltage ranges. Containing a built-in chart take-up plus a means for obtaining tear-off records for short run observations, it is equipped for one in./hr and 15-in./hr operation. Six additional speeds are available as auxiliary operations.



Yellow Springs Instrument Company, Inc., Yellow Springs, Ohio.

PACKAGED CONDITIONERS

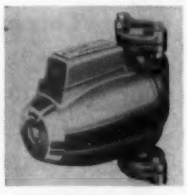
For use wherever high capacity, self-contained air conditioning units are required, this line has been introduced in 10, 15, 20, 25 and 30-hp capacities. Compact and quiet in operation, they are adapted easily for connection to duct work. 20, 25 and 30-hp models are equipped with dual compressors and the 10 and 15-hp units are available with free air discharge plenum and may be had with steam coils in the plenum. All models can be used with steam coils in the duct system and can be furnished with fresh air inlets. Superheaters and permanently lubricated ball bearings are standard on all models.
Dunham-Bush, Inc., 179 South St., West Hartford 10, Conn.

FUEL OIL ADDITIVE

Combining sludge solvent, soot destroyer and rust inhibitor, Triple-X-100 is a slightly viscous, free-flowing liquid which can be introduced into the fuel oil either manually or through solenoid-controlled meters. Added directly to #4, 5 or 6 oil, it puts bottom sludge into a compatible solution which mixes freely with oil bodies, at the same time blending with the fuel oil and volatizing so that particles of metallic stearates surround carbon molecules, lowering the ignition point of the soot to 650 F. Rust inhibitor coats the tank surface to prevent corrosion and pitting.
Parke-Hill Chemical Corporation, 29 Bertel Ave., Mount Vernon, N. Y.

HOT WATER CIRCULATOR

Latest addition to this line, Model 152, has no seals, is water lubricated, requires a min of power and has impeller, rotor and shaft assembled as a single unit. Suited for secondary pumping, it mounts easily in spaces where conventional circulators cannot be installed and may be used for packaged boiler units. It is available with ¾, 1 and 1¼-in. interchangeable flanges.



Taco Heaters Inc., 1160 Cranston St., Cranston 9, R. I.

AIR DUCT

Available in ID sizes from four to twelve in., this industrial air duct for materials handling and abrasive work is produced in standard ten-ft lengths. Designated Type 8R, it is a neoprene coated nylon fabric mechanically interlocked with an electro-galvanized steel spiral. It is engineered to function within an internal temperature range from –20 to 250 F.
Wiremold Company, Hartford, Conn.

FRESH AIR SUPPLY UNITS

Gas-fired heaters with high turndown ratios permit min temperature rise as low as 3.3 F. Fresh air supply units provide warmed air to replace loss through exhaust systems, allowing systems to operate at rated efficiency and removing a source of drafts through doors, windows and other openings to outdoors. In summer units may be operated without heating, to distribute fresh outside air.

Units are available in five sizes, from 15,000 to 50,000 cfm and 1.5 to 4.5 million Btu/hr, based on any clean gaseous fuel with a range of 800 to 3200 Btu/cu ft. Modular design simplifies installation and adaptability to roof or wall intake. Units are completely wired and piped for connection to gas line and electric supply and are available for 220, 440 or 550 volt, three-phase ac.
L. J. Wing Manufacturing Company, Linden, N. J.

REDUCING VALVES

Suited for a variety of water and other liquid pressure reduction applications, valve classes WLK, WK, WHK, WL-2, W-2, WH-2, WLB, WB and WHB are designed for inlet pressures from ten to 300 psi and temperatures up to 180 F. Choice of reduced pressure ranges available covers pressures from five to 100 psi.

Construction features include: large bowl construction and long travel diaphragm to give full flow, tight shutoff, fully guided main valve and renewable trim with interchangeable fit. Valves are available with screwed or flanged ends in cast iron or bronze bodies. Sizes range from ½ to 2 in.
Leslie Company, 107 Delafield Ave., Lyndhurst, N. J.

SIX YEAR-ROUND UNITS

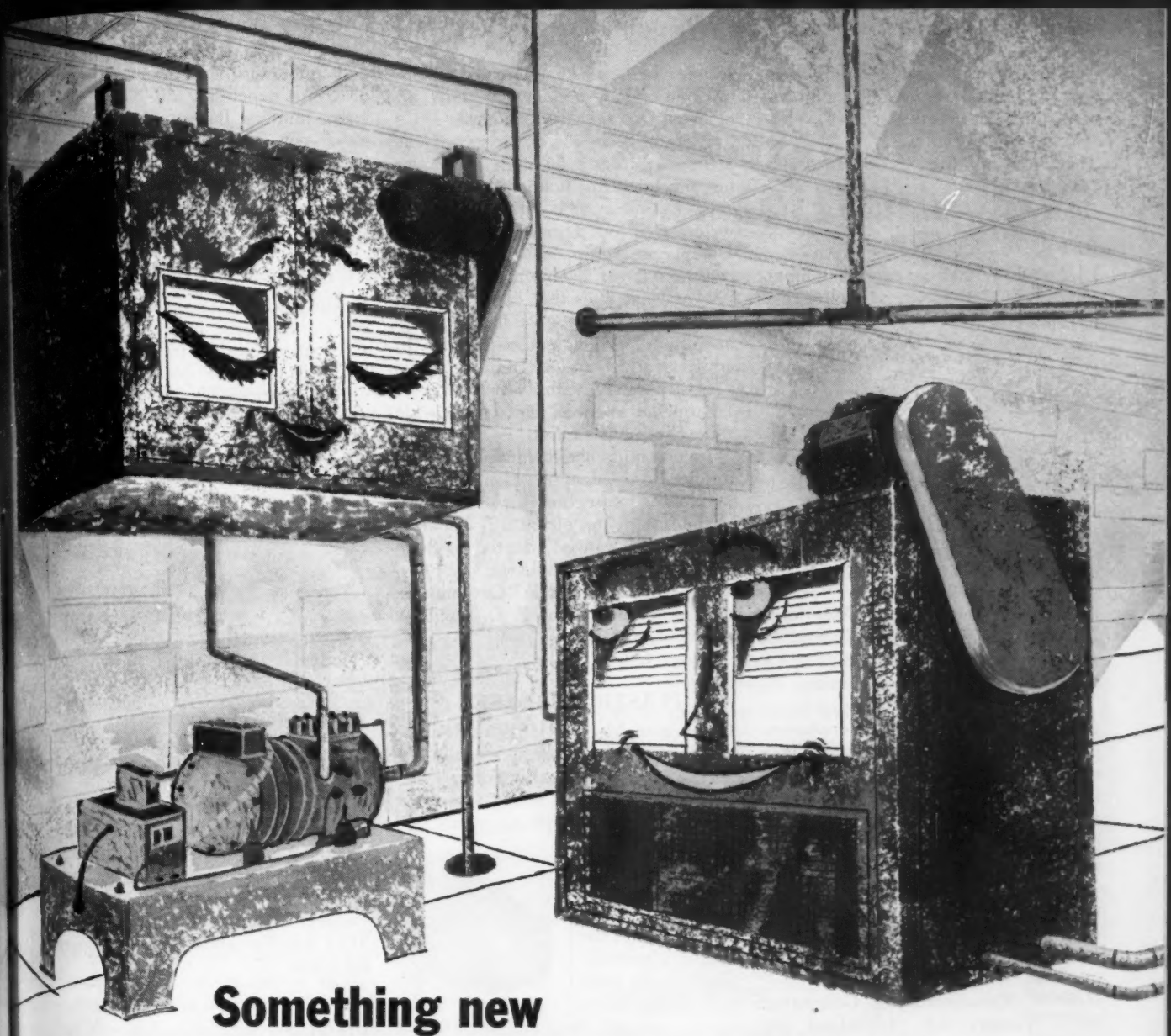
Compactness is featured in the CH line of year-round air conditioning units, which is comprised of six models in two, three, four, five, seven- and one-half and ten-ton capacities. Units can be set up for either heating or cooling and then easily converted to year-round air conditioning at a later date. All models take up to eight rows of cooling coil plus two rows of heating coil. Unit can be remotely mounted and connected to a duct system if desired.

For ease in inspecting and maintaining units, sectional panels provide access to filters, expansion valve, motor and drive. Motors are standard, open 1725 rpm, drip-proof type with resilient base, adjustable mounting and variable pitch pulley.
Bohn Aluminum & Brass Corporation, Danville Div, Danville, Ill.

VIBRATION RESISTANT

Features of this snap-acting temperature control, which is cited as having a high degree of vibration resistance, include rapid temperature response, free calibration, sealed construction and constant thermal and electrical contact. Type PT is used as a high limit or controlling thermostat.

Specifications are: vibration: 5 cps at 0.1-in. displacement through 200 cps at 20 Gs; temperature setting range: –65 to 325 F; ambient range:



Something new for the air conditioning boys... and coils!

Now, Air Handlers from Halstead & Mitchell in 880 to 47,500 CFM Range

AH Series Air Handling Units

Before you buy any Air Handler, check and compare these new H&M units, feature for feature and price for price.

See how easily H&M Air Handlers accommodate matching cooling and heating coils, with space for up to 12 rows of coil depth overall! If you like, H&M coils (from 2 to 68 square feet of face area) can be factory-installed, leaving protruding connections on either side for easy hook-up. Halstead & Mitchell makes the coils you need to match: direct expansion, chilled water, hot water, standard or non-freeze steam. Filter sections are also available.

Performance? H&M Air Handlers deliver air against static loads up to 2-inches water gauge, and do it quietly.

Construction? They're the sturdiest units in the field. Forward curved centrifugal blowers are enclosed in a heavy gauge cabinet featuring formed steel corner posts and flush mounted panels.

Price? Just ask your H&M distributor. You'll be pleased. He has all the engineering information, too. Or, you can write for Bulletin AHU-100, Halstead & Mitchell, Bessemer Building, Pittsburgh, Pa.

HM

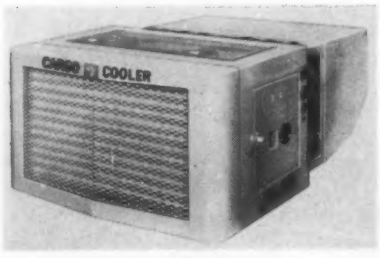
Halstead & Mitchell

Air Handlers • Finned Coils • Air-Cooled Condensers • Cooling Towers • Water-Cooled Condensers

–40 to 300 F; rating: three amp at 32 volt, grounded; operating temperature tolerances: open ± 8 F, close ± 5 F, differential 2 F.
Therm-O-Stats Inc., P. O. Box 303, Chartley, Mass.

REFRIGERATION UNIT

Designed for maintenance of temperatures 30 F and above, Model C-10-B refrigeration unit is a heavy duty model which can be used in insu-



lated truck bodies up to 18 ft long. It is also available, as Model CE-10-B, with ac electric standby power for dockside or overnight operation.

Powered directly by the truck engine, it consists of a self-contained package containing all components except the compressor, and designed for mounting through a prepared opening in the upper front wall of the truck body. Compressor mounts on and is driven by the truck engine by a V-belt from the crankshaft. Evaporator and condenser are powered by a 12-volt, ¼-hp dc motor with heavy duty ball bearings and replaceable brushes.
Hunter Manufacturing Company, 30525 Aurora Rd., Cleveland 39, Ohio.

SILVER SOLDER RINGS

Precision silver solder preform rings, designed for high speed soldering at temperatures ranging from 1150 to 1800 F, can be supplied, depending upon the application, with an overlap, gap or with ends butted in diams from 0.003 to 0.375 in. and with an extensive range of inside diams.

Rings consist of a predetermined amount of a specific silver solder alloy, cited as assuring melting at the proper temperature and the correct volume of solder. Other preform shapes in a variety of solder alloys are also available.
Alloys Unlimited, Inc., 21-01 43rd Ave., Long Island City 1, N. Y.

REMOTE SYSTEMS

Two new remote air conditioning systems with nominal capacities of ten and fifteen ton have been introduced for use in large commercial installations. Outdoor condensing units include high capacity condenser coils located on each side of the unit. Coils are finned-tube type with aluminum fins mechanically bonded to seamless copper tubing and are completely waterless in operation.

Units are equipped with twin compressor systems, each with a matching fan and coil unit, that can be turned on individually to give half-capacity operation for light cooling loads. In addition, the outdoor units can be used separately with two five-ton or 7½-ton fan and coil units to provide zone control if desired.

Indoor units are of modular design for flexibility of application. For example, the fan section can be mounted at the side or top of the coil assembly and the unit can be adapted to three directions of fan discharge.
Westinghouse Electric Corporation, Air Conditioning Div, P. O. Box 510, Staunton, Va.

ALL-PLASTICS BREAKER

Injection-molded of UPVC (unplasticized polyvinyl chloride), this all-plastics vacuum breaker for prevention of backflow in water supply or other high purity piping systems will be manufactured initially in ⅜, ½ and ¾-in. nominal sizes. Incorporated in the unit is a movable disc, wholly within it, which moves

up to close air vents and permit free flow of water or other liquid through the device, then seats itself in a vacuum-tight seal to prevent back siphonage when the flow stops. A removable cap protects air vents against exterior fouling.

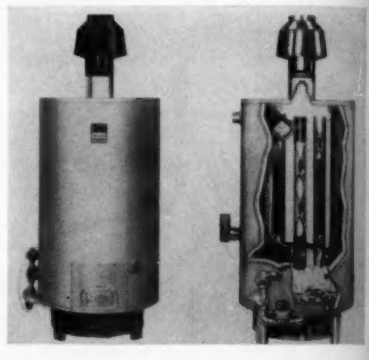
Breaker was tested under vacuums up to 28 in. of mercury with no indication of back siphonage. It was approved for installation in a vertical position a min of 2½ in. above the overflow rim of the fixture it serves for the ½ and ⅜-in. sizes and 7½ in. above the rim for the ¾-in. size.
Tube Turns Plastics, Inc., Louisville 11, Ky.

PANCAKE MOTOR BASE

For use in variable speed sheave installations where space is limited, sliding motor bases of a low "pancake" type have been introduced. Base can be removed quickly and easily to shorten center-to-center distance and free V-belts from the grooves for sheave adjustment. Height of the unit is 1-9/16 or 1-21/23 in. and amount of movement either 4½ or 6 in., depending on Nema motor frame number. Bases with 9-in. movement can be furnished on special order.
T. B. Wood's Sons Company, Chambersburg, Pa.

SWIMMING POOL HEATER

Heating pool water in a large capacity storage tank instead of running the water through tubes as is done in most types of pool heaters, this unit is considerably simplified. Automatic operation, long life, no maintenance and freedom from liming problems are advantages cited for the



heater. Available in five different sizes to heat pools from 11,000 to 35,000 gal capacities, it can be installed in multiples for pools up to 250,000 gal.
Pioneer Manufacturing Company, 3131 San Fernando Rd., Los Angeles 65, Calif.

FILTER

Containing hexachlorophene, this room air conditioner filter material has been designed to trap pollen and air borne bacteria along with other foreign particles. It can be trimmed to fit any size air conditioner.
Owens-Corning Fiberglas Corporation, Toledo, Ohio.

BLOWER WHEELS

Designed specifically for small, 14-in. wide furnaces and compact air conditioners, these spun blower wheels are based on a 4½-in. blade length. With two diams and two types of back plates, the wheels will be available with both single and double air inlets, and will be powered either by direct drive or belt-driven motors. Single inlet style will be produced in nine and ten-in. diams with flat pied out, flat solid or coned solid back plate. Double inlet style will be made in the same diams.
Lau Blower Company, 2027 Home Ave., Dayton 7, Ohio.

(*Continued from page* 88)

angles during the day, the louvers are opened and closed automatically to compensate for this and prevent the sun's rays from entering the windows. On the shaded side of the building or on cloudy days louvers remain open to admit light. Two photoelectric cells mounted on the roof control this activity, overriding the control of the solar time units as the sun goes behind an overcast. Louvers are provided with manual control switches to permit opening of the vanes for window cleaning. For adjustment to the sun's seasonal change from winter to summer, each clock timer has two different program elements, one used from September 21st to March 21st, the other from March 21st to September 21st.

ALL-ELECTRIC FACILITIES FOR APARTMENT HOUSE

Featured in a 13-story, 132-unit apartment house under construction in Philadelphia will be all-electric heating, cooling and lighting. Service will be primary, 13,200 volt, three-phase, three-wire and will consist of two underground cables in conduits encased in concrete. Total connected load in summer will be 2200 kw and in winter 2800 kw. Approximate demand load in summer will be 1000 kw and in winter 1200 kw.

Each room will have electric baseboard heating and a built-in air conditioner, with thermostat temperature control and each apartment will be provided with an electric domestic water heater with thermostat control. Electric heating cable embedded in concrete at the entrance and exit ramps to an underground garage will keep them free of snow and ice in winter. Electrical equipment and appliances will be supplied by General Electric Company.

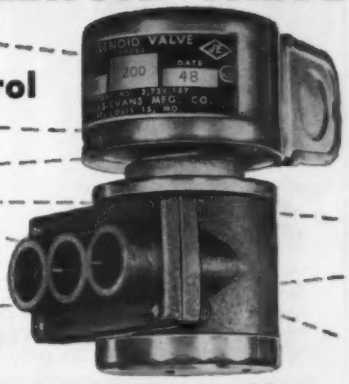
SPIRALLY-WOUND AIR DUCTS USED ON NEW SHIPS

Nine 11,000-ton cargoliners to be put into service next year by Lykes Brothers Steamship Company will utilize a recent development in marine air conditioning by Carrier Corporation. Spirally-wound air ducts supplied in 12-ft lengths are connected into an air conditioning network throughout a ship by factory fabricated couplings and fittings or by means of flexible stainless steel quick couplers. The cylindrical duct is cut to length on the ship as required. Short duct lengths connected by flexible couplings enable simple detours around obstructions such as pipes in the way of duct lines.

Also installed by Carrier in the new ships will be six reciprocating refrigeration machines in each vessel. Two units will air condition passenger staterooms and crew quarters, while the other four will serve 16,000 cu ft of refrigerated cargo space and 4000 cu ft of ships' stores.

J-E TYPE 701 3-WAY SOLENOID VALVE

for flow control of hot or chilled water with fan-coil units



This New addition to the J-E Line provides–

- Economical temperature control.
- Separable solder flange for easy installation.
- One size for ½ to 10 gpm for simple selection

Write for information bulletin today.

Controls Division
JACKES-EVANS MANUFACTURING CO.
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HEATING AND AIR-CONDITIONING ENGINEER—Mechanical Engineer with several years experience in consulting engineering or architectural office, working with heating or air-conditioning design. Position open in product design and development section of manufacturer of air distribution systems for multi-story buildings. Work consists of creative design and experimental models, field engineering trips and some sales contact during introductory period. Send resume of experience, education and salary requirements to Box 963, ASHRAE JOURNAL.

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